No. 2024-1508

UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

APPLE INC.,

Appellant,

v.

LBT IP I LLC,

Appellee.

Appeal from the United States Patent and Trademark Office,
Patent Trial and Appeal Board, in No. IPR2020-01189

CORRECTED OPENING BRIEF FOR APPELLANT APPLE INC.

Jaysen S. Chung, *Principal Attorney*
GIBSON, DUNN & CRUTCHER LLP
One Embarcadero Center, Suite 2600
San Francisco, CA 94111
(415) 393-8271

Brian A. Rosenthal
GIBSON, DUNN & CRUTCHER LLP
200 Park Avenue
New York, NY 10166
(212) 351-2339

Julia G. Tabat
GIBSON, DUNN & CRUTCHER LLP
2001 Ross Avenue Suite 2100
Dallas, TX 75201
(214) 698-3465

Counsel for Appellant Apple Inc.

REPRESENTATIVE PATENT CLAIM

U.S. Patent No. 8,497,774 – Claim 8

8. A local charging management device to manage electrical resource capability for an electronic tracking device that is tracked by at least one other tracking device comprising:

> a battery power level monitor;
>
> a charging unit; and
>
> an electrical power resource management component to adjust cycle timing of at least one of a request rate of location coordinate packets to a target host and a listen rate of the location coordinate packets responsive to an estimated charge level of the charging unit;
>
> wherein the battery power level monitor measures a power level of the charging unit and adjusts a power level applied to location tracking circuitry responsive to one or more signal levels, the power level comprising a multitude of threshold values determined by a user or system administrator to intermittently activate or deactivate the location tracking circuitry to conserve power of the charging unit in response to the estimated charge level of the charging unit.

CERTIFICATE OF INTEREST

Counsel for Appellant Apple Inc. certifies the following:

1. The full name of every entity represented by me is:

   Apple Inc.

2. The parties named in the caption are the real parties in interest.

3. All parent corporations and any publicly held companies that own 10 percent or more of the stock of Appellant are as follows:

   None.

4. The names of all law firms and the partners or associates that appeared for Appellee in the trial court or are expected to appear in this court (and who have not or will not enter an appearance in this case) are:

   ERISE IP, P.A.: Jennifer C. Bailey, Adam P. Seitz, Robin Snader

5. The following cases are related to and/or may be affected by the outcome of this appeal:

   LBT IP I LLC v. Apple Inc., No. 19-cv-1245 (D. Del.)

   LBT IP I LLC v. Apple Inc., Nos. 22-1613, 22-1614, 22-1615, 22-1616, 22-1617 (Fed. Cir.)

6. The following parties were involved in the above-listed cases:

   Apple Inc.

   LBT IP I LLC

7. The following law firms, partners, and associates were involved in the above-listed related cases:

   Erise IP, P.A.: Clifford T. Brazen, Abran J. Kean

   Potter Anderson & Corroon, LLP: David E. Moore, Bindu A. Palapura, Tracey E. Timlin, Stephanie E. O’Byrne

   Taft Stettinius & Hollister LLP: Brian S. Seal and Shaun D. Gregory

Weil, Gotshal & Manges LLP: Brian E. Ferguson, Robert T. Vlasis III, Daniel Musher, Ariane Moss, Audra Sawyer, Anne M. Cappella, Sudip Kundu

Young Conaway Stargatt & Taylor, LLP: Karen L. Pascale, Robert M. Vrana

8. There are no organizational victims or bankruptcy case debtors or trustees in this appeal.

Dated: July 16, 2024

/s/ Jaysen S. Chung

Jaysen S. Chung
GIBSON, DUNN & CRUTCHER LLP
One Embarcadero Center, Suite 2600
San Francisco, CA 94111
(415) 393-8271

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STATEMENT OF RELATED CASES

Pursuant to Federal Circuit Rule 47.5(a), counsel for Apple Inc. states as follows:

The following consolidated appeals before the Patent Trial and Appeal Board were previously before this Court: *LBT IP I LLC v. Apple Inc.*, Nos. 22-1613, 22-1614, 22-1615, 22-1616, 22-1617 (Fed. Cir.). This Court decided those consolidated appeals on June 9, 2023, and the decision was not reported in the Federal Reporter. *See* Appx660-676; *LBT IP I LLC v. Apple Inc.*, No. 22-1613, Dkt. 39, 2023 WL 3914920 (Fed. Cir. June 9, 2023). The panel consisted of Chief Judge Moore, Judge Lourie, and Judge Stoll.

The following case will directly affect or be directly affected by this Court's decision in the pending case: *LBT IP I LLC v. Apple Inc.*, No. 19-cv-1245 (D. Del.). This case is currently administratively closed pending the final outcome of the *inter partes* review being appealed in this case.

STATEMENT OF JURISDICTION

This appeal arises from a Final Written Decision on Remand of the Patent Trial and Appeal Board in IPR2020-01189. Appx1-35. The Board had jurisdiction under 35 U.S.C. § 6. The Board issued its Final Written Decision on Remand on December 15, 2023, (Appx1-35) and Apple timely appealed (Appx723-727). *See* 35 U.S.C § 142; 37 C.F.R. § 90.3. This Court has jurisdiction under 28 U.S.C. § 1295(a)(4)(A).

INTRODUCTION

The Patent Trial and Appeal Board erred in construing the claim term "threshold values" in U.S. Patent No. 8,497,774 to exclude values corresponding to GPS signal levels and limiting the term to include values associated only with battery power levels. The plain language of the claims requires no such exclusion, and the Board's construction omits one of the only two embodiments in the specification describing the term.

The claims at issue are directed to "manag[ing] electrical resource capability for an electronic tracking device" in, for example, a "Global Positioning Satellite ('GPS') system." In a GPS system, a tracking device searches for GPS signals that it uses to determine location. Seeking GPS signals, however, can rapidly deplete a tracking device's battery life. Thus, the claims aim to manage the device's power resources by focusing on the tradeoff between its battery life and the frequency with which it seeks GPS signals. The claims purport to accomplish this task by "intermittently activat[ing] or deactivat[ing]" "location tracking circuitry" in the device based on "threshold values" associated with a "power level."

The Board held that the term "threshold values" is narrowly limited to values corresponding to a *battery* power level and excludes values associated with GPS signal levels. But the Board's construction, which incorrectly equates the recited "power level" and "threshold values" with *battery* power levels, does not follow in

view of the claim language and specification. Nothing in the claims limits the recited "power level" or "threshold values" to a specific type of "power level." Indeed, the claims separately recite a "battery power level" distinct from a "power level," indicating that the former is a narrower subset of the latter and thus that the broader term "power level" can include power levels beyond battery power levels, such as GPS signal levels. The specification supports this understanding, as it describes two subsets of a "power level" and expressly recognizes activating or deactivating the location tracking circuitry of a tracking device based on the "*power level* of [a] receive[d] communication *signal*," *i.e.*, GPS signal.

The Board further erred by holding that "threshold values" must exclude GPS signal level threshold values because "signal levels" is recited as a separate claim term. But the claims also separately recite a "charge level," which the patent treats synonymously with "battery power level." Thus, under the Board's construction, "threshold values" includes values associated with "battery power levels" but not "charge levels," even though the patent treats battery power levels and charge levels as the same. The Board offered no explanation for this self-contradictory result.

Furthermore, the Board's construction ignores this Court's directive that "absent clear evidence to the contrary," claims should not be interpreted "in a way that would omit a disclosed embodiment." *Apple Inc. v. Corephotonics, Ltd.*, 81 F.4th 1353, 1359-60 (Fed. Cir. 2023). Here, there are only two embodiments in the

specification describing threshold values. In one embodiment, the specification discloses "plac[ing] on standby or in a sleep mode" the location tracking circuitry of a tracking device when a "threshold value" corresponding to a low GPS "signal level" is detected. Figure 3 further details this concept of activating or deactivating the location tracking circuitry of a device based on the "power" of a "signal level." The Board nonetheless concluded the term "threshold values" is instead limited to the other embodiment illustrated in Figure 4, which relates to placing location tracking circuitry on sleep or standby mode based on values associated with battery power levels. The Board, however, offered no principled basis to limit the term to that one embodiment at the exclusion of the other.

Accordingly, because the Board's construction finds no support in the claim language and omits one of the specification's only two relevant embodiments, this Court should reverse the Board's construction of "threshold values" and hold that the term includes threshold values associated with GPS signal levels—not just battery power levels. The Court should remand for the Board to consider whether, under that correct construction, Apple has demonstrated the challenged claims of the '774 patent are unpatentable as obvious.

STATEMENT OF THE ISSUES

Whether the Board erred by construing the term "threshold values" as limited to values corresponding to battery power levels and excluding values corresponding to received GPS signal levels.

STATEMENT OF THE CASE

Apple filed a petition for *inter partes* review of LBT's '774 patent, contending that all claims are unpatentable as obvious. Appx57; Appx62. The Board instituted review and found all challenged claims obvious over Japanese Unexamined Patent Application Publication No. 2004-37116A ("Sakamoto"). Appx584-653.

After LBT appealed, this Court vacated and remanded the Board's decision, holding that the term "multitude of threshold values" in claims 8, 10, 13, and 15 requires more than two threshold values. Appx660-676; *LBT IP I LLC v. Apple Inc.*, No. 22-1613, Dkt. 39, 2023 WL 3914920 (Fed. Cir. June 9, 2023). The Court recognized, however, that Apple preserved an argument that Sakamoto disclosed four threshold values—two related to GPS signal level thresholds and two related to battery level thresholds—and instructed the Board to determine on remand whether three or four threshold values is sufficient to constitute a "multitude." Appx672.

On remand, however, the Board did not address that question. Instead, it ordered claim construction briefing on whether the term "threshold values" is limited to values associated with "battery power level threshold values," or whether it could

also include values corresponding to "signal level threshold values." Appx677-680. The Board ultimately concluded that "threshold values" excludes values corresponding to GPS signal levels. Appx1-35. Apple appeals that construction.

I. The '774 Patent

A. Background of the Invention

1. Claims 8, 10, 13, and 15 of the '774 patent at issue on appeal are directed to "manag[ing] electric resource capability for an electronic tracking device" in a location tracking system. Appx55 (16:43-61). In conventional systems, tracking devices employed integrated "accelerometers" that "detect, measure, and monitor" certain factors such as vibrations and acceleration to determine location, angle, and tilt. Appx48 (1:41-2:56). These systems, however, are prone to "measurement errors" that can compromise their accuracy. *Id.* (2:46-56).

The patent refers to another type of system used for location tracking called a "Global Positioning Satellite ('GPS') system." *Id.* (2:57-62). In a GPS system, a tracking device with location tracking circuitry searches for GPS signals that contain location coordinate information used to determine the device's location. *Id.*; Appx51 (7:29-49); Appx50 (5:45-63). A tracking device may seek GPS signals at predefined intervals of time. Appx49 (4:37-49); Appx54 (14:1-15); *id.* (14:42-47). How often the device searches for these signals is referred to as its "listen rate," and how often location coordinate packets are transmitted is referred to as its "request

rate." Appx53 (11:31-43); *id.* (12:32-49); *see* Fig. 5. Taken together, the frequency with which the device updates its location is the "refresh rate" or its "update rate." Appx53 (11:31-43); *id.* (11:53-57); Appx54 (13:40-43); Appx55 (15:13-21).

2. There is a tradeoff between a tracking device's battery life and how often the device attempts to update its location—namely, the more often a device seeks GPS signals and transmits its location, the more quickly its battery is depleted. *E.g.*, Appx51-52 (8:67-9:17) ("the present invention conserves battery power by placing on standby, low power mode, or disabling entirely GPS signal acquisition circuitry"); Appx51 (8:4-11) ("location tracking circuitry 114, may be placed in a sleep or standby mode to conserve a battery level of the battery 118"); Appx54 (13:63-67) (users or system administrators can "intermittently activate or deactivate location tracking circuitry…to conserve power of the power charging unit (e.g., battery 118)"); Appx55 (15:17-21) (referring to the "tradeoff" between the "estimated charge life" and the "update rate … of location information").

Furthermore, if the device is in a "covered structure," and thus the GPS signals are weak because they are "obstructed or partially blocked," the device's battery will be depleted in its "failed attempts" to obtain a better signal. Appx48-49 (2:64-3:11). The specification also discusses scenarios where using a GPS tracking device at a high update rate may be preferred over conserving battery (*e.g.*, tracking a lost dog that has a portable location tracking device), or where conserving battery may be

preferred if frequently obtaining GPS signals is unnecessary (*e.g.*, a construction equipment provider desiring to know the location of equipment only once per day). Appx54 (14:1-15); *id.* (14:39-57); *see also id.* (14:16-39).

In addition, a conventional GPS tracking device has limited ability to control or even monitor its own battery usage. Appx49 (3:11-15) ("during the acquisition of signaling and or other information, a conventional GPS transceiver has limited functionality or capabilities associated with control and monitoring of battery power usage"); *see also id.* (3:16-50). Accordingly, a device with a low battery may continue searching for GPS signals, and therefore further deplete its battery, even though it may not be preferable to do so. *Id.* (3:4-11) ("Not only is a GPS transceiver receiving a weak GPS signal, but also the GPS transceiver is depleting battery power in failed attempts to acquire communication signals from one or more location coordinates monitoring satellites, e.g., GPS satellites[.]").

B. The Appealed Claims of the '774 Patent

Appealed claims 8, 10, 13, and 15 of the '774 patent involve "manag[ing] electrical resource capability for an electronic tracking device" by focusing on the tradeoff between how often (and by what means) the device attempts to ascertain location and its battery life. Appx38 (Abstract); Appx49 (3:55-4:50). Independent claim 8 is representative, and recites (Appx55 (emphasis added)):

> A local charging management device to manage electrical resource capability for an electronic tracking device that is tracked by at least one other tracking device comprising:
>
> a battery power level monitor;
>
> a charging unit; and
>
> an electrical power resource management component to adjust cycle timing of at least one of a request rate of location coordinate packets to a target host and a listen rate of the location coordinate packets responsive to an estimated charge level of the charging unit;
>
> **wherein the battery power level monitor measures a power level of the charging unit and adjusts a power level applied to location tracking circuitry responsive to one or more signal levels, the <u>power level comprising a multitude of threshold values</u> determined by a user or system administrator to intermittently activate or deactivate the location tracking circuitry to conserve power of the charging unit in response to the estimated charge level of the charging unit**.

The claim recites a "power level comprising a multitude of threshold values . . . to intermittently activate or deactivate" "location tracking circuitry" in the tracking device. Appx55 (claim 8). This "power level" is not limited in the claim to any particular type of "power level." In addition, although the claim recites that the "power level compris[es] a multitude of threshold values," and thus requires that the "power level" include "threshold values," the claim does not specify or limit the type of information to which the "threshold values" may correspond.

The specification is consistent with this claim language. For example, the specification refers to different types of power levels, including the power level of a

GPS signal. *E.g.*, Appx52 (10:38-52) (referring to the "power level of [a] receive communication signal," *i.e.*, GPS signal); Appx51 (7:22-25) (referring to a "signal power level"). And, as discussed below, there are two embodiments that employ threshold values—associated with either GPS signal levels or battery power levels—upon which the location tracking circuitry is activated or deactivated. *Infra* pp. 9-15.

Claims 10, 13, and 15 depend on claim 8. Appx56 (claims 10, 13, and 15). Claim 10 adds "wherein the local charging management device comprises a charge control management of the portable electronic tracking device that estimates charge capability and adjusts cycling of the at least one of a request rate of location coordinate packets to a host target and a listen rate of the location coordinate packets to maximize charge capability." *Id.* (claim 10). Claim 13 adds "wherein the listen rate of the location coordinates comprises a global positioning system (GPS) system refresh rate of the location coordinates." *Id.* (claim 13). Claim 15 adds "wherein the battery power level monitor measures a power level of the charging unit and substantially automatically adjusts power usage responsive to available power of the charging unit to maximize power unit life." *Id.* (claim 15).

C. The Two Embodiments in the Specification Describing "Threshold Values"

Consistent with the claims, the patent describes two options of managing a tracking device's power resources—by, for instance, adjusting the power level

applied to its location tracking circuitry—using threshold values corresponding to *either* a (1) GPS signal level *or* (2) battery power or charge level. *E.g.*, Appx51 (7:55-62) (signal levels); Appx54 (13:52-67) (battery levels). Each embodiment discloses employing user-adjustable values (corresponding to either the power level of the battery or the GPS signals) to strike the desired tradeoff between (1) the accuracy and frequency of location tracking updates and (2) battery life.

GPS Signal Level Threshold Embodiment. As to the first option, the specification explains that when "a first signal level, e.g., a low signal or threshold value, as specified by, for instance, a user or system administrator," is "detect[ed]," the "electrical circuitry associated with GPS signal acquisition" is adjusted such that it is placed "on standby or in a sleep mode." Appx51 (7:50-62). In that scenario, an accelerometer, which does not rely on GPS signals, is instead used for location determination when the received GPS signals are too low. Appx52 (10:38-52).

Figure 3 further describes this concept. Appx43 (Fig. 3); Appx52 (10:38-67). The figure depicts using GPS signal level thresholds to manage the tradeoff between battery life and frequent location updates by, for instance, applying or disabling power to the location tracking circuitry. *Id.* In particular, it shows a "flow chart" (Appx52 (10:38-41)) for "manag[ing] and control[ling] circuitry associated with the electronic tracking device" (Appx50 (5:1-4)):

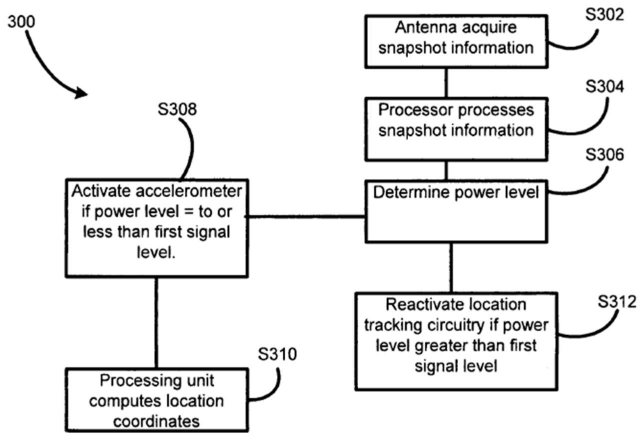

Figure 3

Appx43 (Fig. 3). The tracking device receives a "communication signal" that includes "location coordinates data," *i.e.*, a GPS signal. Appx52 (10:38-52). Based on the "power level of [the] receive[d] communication signal" (*id.* (10:46-47)), the device adjusts the power level of the location tracking circuitry by either: (1) deactivating the location tracking circuitry if the signal level is below a threshold value and activating an accelerometer to instead track location (S308, where the communication signal is "[equal] to or less than [a] first signal level," and therefore "insufficient for processing"); or (2) reactivating the location tracking circuitry and reverting to the GPS system if the signal level is above a threshold value (S312, where the "power level [is] greater than [the] first signal level," and therefore the power level of the GPS signal is of "sufficient signal strength"). Appx43 (Fig. 3);

Appx52 (10:38-67).

Notably, box S308 in Figure 3 states that the tracking device activates the accelerometer if the "**power level** [**equals**] [] or [is] less than [the] first **signal level**" and, alternatively, box S312 activates the location tracking circuitry if the "**power level** [is] greater than [the] first **signal level**." Appx43 (Fig. 3) (emphases added). Thus, in this regard, Figure 3 expressly equates quantifiable values corresponding to GPS "signal levels" with a power level. *Id.*; Appx52 (10:39-52) (Figure 3 uses processing unit 104 to "determine[] a **power level** of **receive communication signal**") (emphasis added).

Accordingly, in this embodiment, the patent describes adjusting power resources by activating or deactivating the location tracking circuitry of a tracking device based on whether a GPS signal level is above or below a certain threshold. *E.g.*, Appx50 (5:1-4) ("FIG. 3 illustrates a flow diagram to manage and control circuitry associated with the electronic tracking device of FIGS. 1 and 2 in accordance with an embodiment of the present invention"); Appx51-52 (8:67-9:17) (describing embodiment that "conserves battery power by placing on standby, low power mode, or disabling entirely GPS signal acquisition circuitry" "when GPS signaling is not practicable"); Appx51 (8:4-16) ("location tracking circuitry 114, may be placed in a sleep or standby mode to conserve a battery level of the battery"

by "periodically check[ing] availability of GPS signal" "to determine if a receive communication signal is above a first signal level").

Battery Power or Charge Level Threshold Embodiment. As to the second option, rather than adjusting the power level applied to the location tracking circuitry based on *signal* level thresholds, the "power level" is "adjust[ed]" based on a selected "threshold value" associated with an "estimated charge level (e.g., battery charge level 406)." Appx54 (13:52-67) ("[T]he present invention has the capability of power level (e.g., battery power level 406) adjustments"). The specification uses the terms "charge level" and "battery power level" synonymously. *E.g.*, *id.* (referring to 406 in Figure 4 interchangeably as "battery charge level" and "battery power level"); *id.* (13:15-16) ("estimate charge level (e.g., battery level 406)"). Figure 4 depicts the second option of preserving battery power:

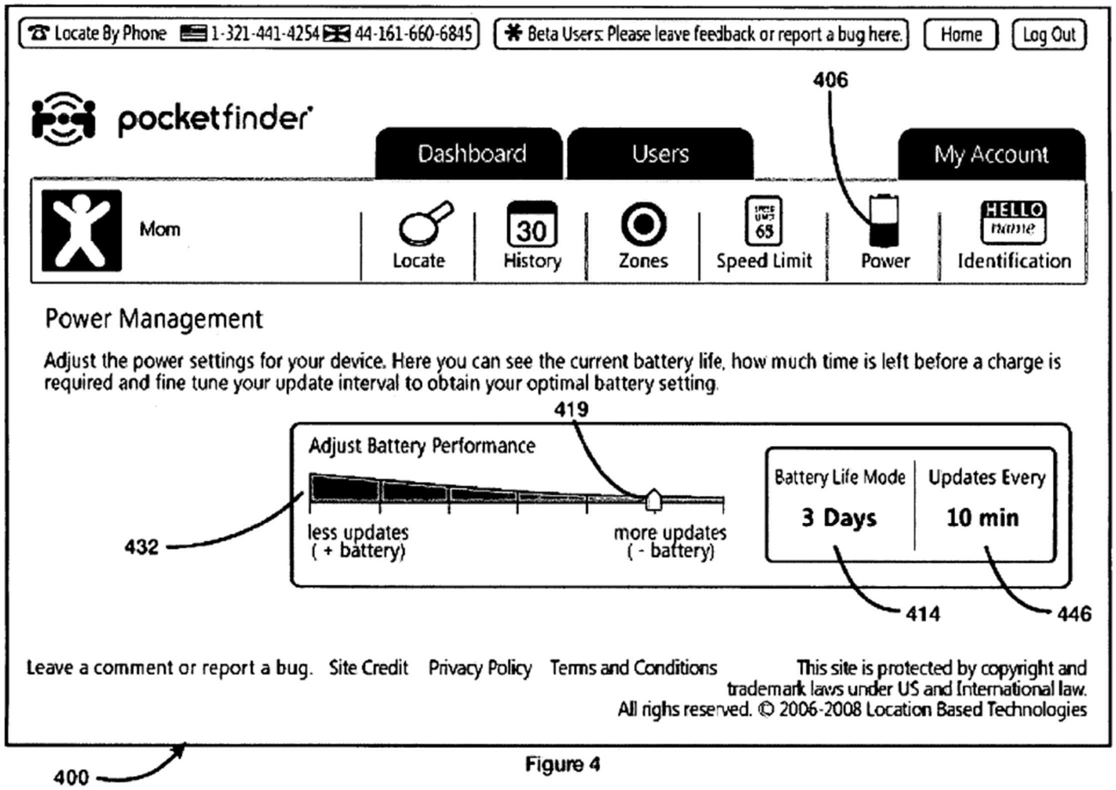

Figure 4

Appx44 (Fig. 4). In this embodiment, the user can "intermittently activate or deactivate location tracking circuitry" and thus "conserve power of the power charging unit" by adjusting a slider corresponding to a particular value 419 associated with the battery's charge level. Appx54 (13:52-67); Appx53 (11:44-67). This allows the user to view the "real-time trade-off relationships between remaining battery charge level 414 and update rate 446 (e.g., refresh rate) of location coordinate packets" "to achieve a desired user defined battery operating environment, e.g., obtain optimal battery life, obtain optimal update rate, tradeoffs between them." Appx54 (11:44-67). Thus, Figure 4 illustrates that the power level applied to the

location tracking circuitry is "responsive" to an estimated "charge level," *i.e.*, battery power level. *Id.* (13:1-18); *id.* (13:58-67).

Other than these two embodiments, the specification does not define "threshold value," place any limits on the term's scope, or even mention the term. Appx51 (7:50-62) (signal levels); Appx54 (13:52-67) (battery power levels).

II. Procedural History

A. *Inter Partes* Review Proceedings

On July 20, 2020, Apple filed a petition for *inter partes* review of the '774 patent, alleging that claims 1, 4, 5, 6, 8, 10, 13, and 15 are unpatentable as obvious. Appx67. Apple explained that the prior art reference Sakamoto rendered those claims obvious, either alone or in combination with other prior art. *Id.* LBT filed a Preliminary Patent Owner Response on December 9, 2020. Appx155; Appx176.

On March 4, 2021, the Board instituted IPR proceedings (Appx179-208), determining that Apple had demonstrated a "reasonable likelihood that it would prevail with respect to at least one challenged claim in the Petition." Appx206. The Board preliminarily construed the term "multitude" in certain claims requiring a "multitude of threshold values" to "include two" or more threshold values, but did not construe "threshold values." Appx189-192.

LBT opposed the Board's preliminary construction of "multitude." *See* Appx285; Appx408. But LBT never offered a construction for or contended the

Board should have construed the term "threshold values." *See* Appx285; Appx408. In response, Apple explained that even under a construction of "multitude" requiring more than two threshold values, Sakamoto discloses the claim limitation. Appx321-325. Apple pointed to four values in Sakamoto that can be configured to conserve battery charge or activate location tracking circuitry: two values corresponding to the "remaining battery amount" (or battery charge) of the device and two "associated with a GPS signal level." *Id.* Apple argued all four of these values are "threshold values" within the meaning of the claims. *Id.*

On March 2, 2022, the Board issued its Final Written Decision, holding all challenged claims unpatentable as obvious in view of Sakamoto.[1] Appx584-653. The Board construed "multitude" to include two threshold values and held that "no other terms require explicit construction." Appx595-602. The Board held that Sakamoto discloses at least two threshold values that can be adjusted based on the battery power level of the apparatus—a fact that LBT had not disputed. Appx624-625. The Board did not reach Apple's alternative argument regarding Sakamoto's disclosure of two additional threshold values corresponding to GPS signal levels.

[1] The Board also denied a motion to amend by LBT, which is not at issue on appeal. Appx586.

B. LBT Appeals the Construction of "Multitude"

LBT appealed the Board's construction of "multitude" as recited in claims 8, 10, 13, and 15 of the '774 patent. Appx668. This Court disagreed with the Board and held that a "multitude" of threshold values requires more than two threshold values. Appx672. Nevertheless, this Court recognized Apple had preserved the argument that "Sakamoto discloses at least four threshold values—two battery level thresholds and two GPS signal level thresholds." *Id.* The Court therefore directed the Board to consider on remand "whether multitude encompasses three or four threshold values and whether the two sets of threshold values disclosed in Sakamoto teach a multitude of threshold values." *Id.*

C. The Board Construes "Threshold Values" as Limited to Battery Levels and as Excluding GPS Signal Level Threshold Values

On remand, the Board did not address the question this Court had directed the Board to answer. Instead, the Board requested claim construction briefing on the new question of "whether the recited 'threshold values' are limited to battery power level threshold values or whether they may also include signal level threshold values." Appx679-680. The Board requested "simultaneous opening and responsive claim construction briefs," and precluded the parties from submitting new evidence "except file histories . . . (if necessary)." Appx679.

In its opening brief, Apple explained that the construction of "threshold values" must include "GPS signal level threshold values" when read in light of the

specification, which expressly teaches such an embodiment, and that the "plain language of the claim itself" did not exclude that embodiment. Appx694 (citing Appx51 (7:55-59)); Appx698-699. Apple further detailed that the specification, including Figure 3 specifically, discloses conserving power in a tracking device by deactivating the location tracking circuitry of the tracking device (*e.g.*, GPS transceiver) when a "low signal level or threshold value" is detected and instead using the device's accelerometer for location determination. Appx695-696 (citing Appx51-52 (7:55-8:3, 8:7-16, 8:67-9:3)) (emphasis omitted).

By contrast, in its opening brief, LBT ignored Figure 3 and instead focused on Figure 4, which corresponds to the specification's discussion of "threshold values" in conjunction with a battery power or charge level. Appx687-688. LBT also contended that certain dependent claims from the prosecution history supported its construction. *Id.*

In its responsive brief, Apple explained that LBT "completely ignore[d] the GPS signal level embodiment described in columns 7-10" and disregarded the "broad, plain language used in claim 8," which does not exclude "threshold values" corresponding to GPS signal levels. Appx704; Appx708. LBT argued in its responsive brief that Apple "improperly conflate[d] the distinct embodiments of [Figures] 3 and 4," and that the fact the patent "discloses a single GPS signal level

threshold does not overcome the clear disclosure of two distinct types of threshold values." Appx719.

On December 15, 2023, the Board issued its Final Written Decision on Remand. Appx1-35. The Board concluded that GPS "signal level threshold values are not within the scope" of the claim term requiring "the power level comprising a multitude of threshold values." Appx21. The Board held that the "natural reading" of claim 8 associates a "power level" with the "multitude of threshold values," and that "the claim language already incorporates a limitation directed to 'signal levels.'" Appx15-16. The Board further suggested that signal levels cannot be threshold values based on the claim language because the "purpose" of the threshold values is to "conserve power of the charging unit." *Id.* As to the specification, the Board held that the "only reference to a 'multitude of threshold values'" appears in conjunction with battery power levels, and that the specification therefore "directly links the 'multitude of threshold values' with battery power level 406," as shown in the embodiment of Figure 4. Appx16-17.

The Board acknowledged the specification does in fact "use[] the word threshold value" in a second passage, which references a "low signal level." Appx17-18. Yet, here, the Board stated that "the mere use of the word 'threshold' in this context does not tie embodiments pertaining to a signal level, such as the one described in Figure 3, to the recitation 'the power level comprising a multitude of

threshold values'" without offering a basis for this distinction. Appx18. The Board further held that "signal levels" cannot be "threshold values" because claim 8 "already recites that the battery power level monitor adjusts the battery power level 'applied to location tracking circuitry responsive to one or more signal levels,' which incorporates the notion of responding to a signal level threshold." Appx18-19 (emphasis omitted).

Finally, as to LBT's argument concerning the prosecution history, the Board stated that the prosecution history lent "some support" to a construction that "threshold values" "relates to battery power levels and not signal levels," but did not provide further discussion on the subject. Appx21.

Under its construction of "threshold values," the Board rejected Apple's alternative argument that Sakamoto discloses four threshold values—two corresponding to battery power levels and two corresponding to GPS signal levels. Appx31-32. Thus, the Board did not reach the question of whether a "multitude" of threshold values may include three or four values, and concluded that Apple had not shown the challenged claims to be unpatentable as obvious under the Board's new construction of "threshold values." Appx33. Apple appeals the Board's construction of "threshold values."

SUMMARY OF ARGUMENT

This Court should reverse the Board's construction of "threshold values" and hold that the term includes threshold values associated with GPS signal levels—not just battery power levels. The Court should remand for the Board to consider whether Sakamoto discloses a "multitude of threshold values" under the correct construction. The Board committed three categories of error.

I. The Board erred in concluding the "natural reading" of the claims requires limiting "threshold values" to battery power levels at the exclusion of GPS signal levels. For example, the Board incorrectly equated "power level" and "threshold values" with only *battery* power levels, which is not supported by the claim language. To the contrary, the term "power level" in claim 8 encompasses different types of power levels, including the power of GPS signal levels, and is not restricted to battery power levels. Indeed, claim 8 separately refers to a "battery power level" as distinct from a "power level," which under basic claim construction principles indicates that a "battery power level" is distinct from—and is a narrower subset of—a "power level." The specification likewise makes clear that "power level" includes a GPS signal power level.

In addition, the Board held that the "comprising" language in the phrase "the power level comprising a multitude of threshold values" requires that "whatever follows" the "comprising language" "must still be a 'power level.'" However,

although the "comprising" language means that "power level" *includes* "threshold values," nothing in the claims limits "threshold values" to only *battery* power levels, let alone excludes values corresponding to GPS signal levels.

Furthermore, the Board erred in holding that GPS signal levels must be excluded from "threshold values" because "signal levels" is a separately recited claim term. The claims also separately recite "charge levels," which the patent treats synonymously with "battery power levels." Thus, the Board's reasoning that "signal levels" must be excluded from "threshold values" because the term appears elsewhere in the claims would necessarily exclude "charge levels" from "threshold values" as well. Such a conclusion, however, is directly at odds with the Board's construction, which held that threshold values are necessarily values corresponding to battery power—and thus, charge—levels.

II. In addition, the Board's construction disregards this Court's instruction that "absent clear evidence to the contrary," claims should not be interpreted "in a way that would omit a disclosed embodiment." *Apple*, 81 F.4th at 1359-60. The specification discloses only two embodiments describing the term "threshold value"; indeed, the term itself is used only twice in the specification. Appx51 (7:55-59); Appx54 (13:58-67). Both embodiments employ user-adjustable values to strike the desired tradeoff between a tracking device's method for updating its location (and the frequency with which it seeks and transmits location updates) and its battery life.

The only meaningful difference between the two embodiments is what those user-adjustable values are: in one, GPS signal level thresholds are the values (*e.g.*, Figure 3), whereas battery power or charge levels are the values in the other (*e.g.*, Figure 4). Indeed, the patent makes clear that values associated with both GPS signal level thresholds and battery charge level thresholds may determine how the "power level" of the same location tracking circuitry is adjusted. Yet, the Board limited "threshold values" to the latter embodiment while omitting the former without any meaningful basis.

III. Finally, contrary to the Board's decision, the prosecution history does not support its construction. The Board relied on two claims submitted during prosecution (and later amended) that have separate limitations regarding activating and deactivating location tracking circuitry to support its conclusion that signal levels are not included in threshold values. But these claims did not exclude signal levels from threshold values, nor did the Patent Office or the applicant remark on the scope of "threshold values" during prosecution. Accordingly, these two claims (and the rest of the prosecution history) do not evince a clear and unmistakable disclaimer of the scope of "threshold values."

STANDARD OF REVIEW

Claim construction is a question of law reviewed de novo. *Apple*, 81 F.4th at 1357-58. Where, as here, the Board relies solely on intrinsic evidence to construe

the claims, the Board's determinations are afforded no deference, and this Court "decide[s] the proper claim construction" de novo. *Id.*; *ABS Glob., Inc. v. Cytonome/St, LLC*, 84 F.4th 1034, 1040 (Fed. Cir. 2023); *see also Seabed Geosolutions (US) Inc. v. Magseis FF LLC*, 8 F.4th 1285, 1287 (Fed. Cir. 2021) (stating that "supporting determinations" based on intrinsic evidence are subject to de novo review). In cases "involving reversal of a Board claim construction, the appropriate course of action is to vacate the Board's decision and remand the matter." *ABS*, 84 F.4th at 1042.

ARGUMENT

The Board erred in construing "threshold values" to exclude values associated with GPS signal levels. The Board's construction finds no support in the claim language and reads out one of the only two embodiments of a "threshold value" described in the specification. The prosecution history also lends no support to the construction, as it evinces no clear and unmistakable disclaimer of claim scope. Thus, this Court should reverse the Board's construction and remand for a determination of whether Sakamoto renders the claims unpatentable under the correct construction of "threshold values" that includes values associated with GPS signal levels.

I. The Board Improperly Narrowed the Claim Language to Exclude "Threshold Values" Corresponding to GPS Signal Levels

The Board's construction restricting "threshold values" to battery power levels based on the claim language was error for the three reasons discussed below.

1. According to the plain language of the claims, the term "threshold values" has no restriction that would exclude threshold values associated with GPS signal levels. *Apple*, 831 F.4th at 1358 ("We begin, as we often do, with the claim language."). The relevant portion of claim 8 begins with a "battery power level monitor" that performs particular functions including: (1) measur[ing] "a power level of the charging unit" (*e.g.*, battery); and (2) adjust[ing] "a power level of the location-tracking circuitry responsive to" "one or more signal levels." Appx55 (16:53-61). The claim then recites that the adjusted "power level" includes "threshold values determined by a user or system administrator to intermittently activate or deactivate the location tracking circuitry to conserve power of the charging unit in response to the estimated charge level of the charging unit." *Id.*

Thus, the claims require "threshold values," and activating or deactivating location tracking circuitry based on those values. But the plain language of the claims does not require that these "threshold values" be associated with a particular type of power level. To the contrary, as discussed below, the claims read in view of the specification confirm that the "power level of [a] receive[d] communication signal," *i.e.*, a GPS signal level, can be a threshold value used as a basis to activate

or deactivate the location tracking circuitry. Appx52 (10:38-67); Appx51 (7:55-62) ("a low signal level or threshold value" may "activate" the accelerometer and place "electrical circuitry associated with GPS signal acquisition" "on standby or in a sleep mode"); *infra* pp. 34-42.

Nevertheless, the Board concluded claim 8's "natural reading" requires that "the 'power level' associated with the 'multitude of threshold values' is the battery power level that is (1) measured by the battery power level monitor and (2) adjusted by the battery power level monitor and applied to location tracking circuitry." Appx16. The Board likewise held that the "comprising" language in the phrase supported its interpretation because "the power level comprising a multitude of threshold values" means that "whatever follows the term 'comprising' in this limitation must still be a 'power level' to be within the scope of the claim." Appx19. The Board's conclusion was error for two primary reasons.

First, the Board's construction incorrectly equated "power levels" and "threshold values" with only *battery* power levels at the exclusion of GPS signal power levels. That reasoning does not follow in view of the claim language. The claims separately refer to a "battery power level" distinct from a "power level" (Appx55 (16:53-61)). Fundamental claim construction principles dictate that the broader term ("power level") should be read to encompass—and not to be limited to—the narrower term ("battery power level"). *Promptu Sys. Corp. v. Comcast*

Corp., 92 F.4th 1372, 1382 (Fed. Cir. 2024) ("The absence of the 'centralized' modifier in the claims, in turn, means that the claimed 'wireline node' must be broader in some way than the 'centralized wireline node' defined in the specification."). Had the applicants intended for "power level" to be limited to *battery* power levels, they therefore knew how to specify that in the claim language. But they did not do so with respect to the term "power level."

The specification also supports this understanding. It refers to a "battery power level" as a mere *example* of a type of "power level" (Appx54 (13:44-51)) ("measures a power level (*e.g.*, **battery power level** 406)") (emphasis added); Appx54 (13:52-56) ("adjusts a power level (e.g. **battery power level** 406)") (emphasis added). Elsewhere, the specification refers to another type of power level—a "signal power level." *See* Appx51 (7:22-29) ("a signal detecting circuitry 115 detects and measures **signal power level**") (emphasis added); *id.* ("the signal processing circuitry 104 processes and measures **signal power level**") (emphasis added). "Power level" therefore cannot be read as narrowly limited to "battery power level," and instead can also refer to other types of power levels, including a "signal power level." *Cordis Corp. v. Medtronic Ave, Inc.*, 511 F.3d 1157, 1173-74 (Fed. Cir. 2008) ("slots" could not be construed to mean only "complete slots" where the specification referred to both "half-slots" and "complete slots"). The Board thus

erred in limiting "power levels" to "battery power levels" at the exclusion of GPS "signal power levels."

Second, although the phrase "power level comprising a multitude of threshold values" means that the "power level" must include "threshold values," there is nothing in the claims requiring that these "threshold values" correspond only to *battery* power levels, much less exclude values corresponding to GPS signal levels. *See CIAS, Inc. v. Alliance Gaming Corp.*, 504 F.3d 1356, 1360 (Fed. Cir. 2007) ("In the patent claim context the term 'comprising' is well understood to mean 'including but not limited to.'"); *Seabed*, 8 F.4th at 1287 (Fed. Cir. 2021) (holding that claim language describing a geophone's "relationship with [its] housing" did not limit a geophone to a particular "type of geophone"); *WundaFormer, LLC v. Flex Studios, Inc.*, 680 F. App'x 925, 931 (Fed. Cir. 2017) (non-precedential) ("The term 'comprising' indicates the claim is open-ended and does not exclude additional, unrecited elements.") (citing *Gillette Co. v. Energizer Holdings Inc.*, 405 F.3d 1367, 1371-73 (Fed. Cir. 2005)).[2] Indeed, the claims expressly contemplate activating or deactivating location tracking circuitry "responsive to one or more signals," *i.e.*,

[2] The Board held that "the word 'comprising,' here is in the body of the claim" and therefore has "no special legal effect." Appx20 (quoting *Moleculon Rsch. Corp. v. CBS, Inc.*, 793 F.2d 1261, 1272 n.8 (Fed. Cir. 1986)). But *Moleculon* did not hold that "comprising" can *never* mean "including but not limited to" when used in the body of a claim; to the contrary, in *WundaFormer*, this Court held that the word "comprising" used in the body of a claim "di[d] not exclude additional, unrecited elements." 680 F. App'x at 931 (non-precedential).

based on threshold values corresponding to GPS signals. Appx55 (16:53-61). Accordingly, because nothing in the claim language precludes "threshold values" from including values corresponding to the "power level" of a GPS "signal level," the Board erred by narrowly construing the term to exclude "threshold values" associated with GPS "signal levels." *See Google LLC v. EcoFactor, Inc.*, 92 F.4th 1049, 1058 (Fed. Cir. 2024) (holding that claim language is entitled to a "broader reading" if it "places no constraint" on the scope of the term); *Evolusion Concepts, Inc. v. HOC Events, Inc.*, 22 F.4th 1361, 1366 (Fed. Cir. 2022) (holding that the "generic term" "magazine catch bar" did not exclude particular types of magazine catch bars where "nothing in the language of [the] claims" limited the term).

2. The Board further erred in holding that "threshold values" cannot include values corresponding to GPS signal levels because the term "signal levels" is separately recited elsewhere in claim 8. Appx16. The Board's reasoning is at odds with the claim's separate recitation of the term "charge levels," which is necessarily encompassed within the Board's construction of "threshold values." Specifically, under the Board's holding, "charge levels" likewise must be excluded from "threshold values" because the term is also separately recited by claim 8. But that conclusion directly conflicts with the Board's tacit acknowledgement that the term "threshold values" *includes* values associated with "charge levels"—indeed, even the specification treats "charge levels" synonymously with "battery levels."

Compare Appx53 (11:11-15) ("battery charge level 406"); Appx54 (13:13-18) ("estimate charge level (e.g., battery level 406)"); Appx53 (11:44-53) ("battery charge level 406" is "responsive to value 419" determined by a user), *with* Appx16-17 ("the specification directly links the 'multitude of threshold values' with battery power level 406"). The Board offered no explanation for this contradiction.

Furthermore, the Board mistakenly relied on *Chicago Board Options Exchange, Inc. v. International Securities Exchange, LLC*, to conclude that "different meanings" must be "ascribe[d]" "to the recited 'signal levels' and 'power level.'" Appx16. As an initial matter, the Board answered the wrong question. The question is not whether "signal levels" and "power levels" have the same meaning. Instead, the question is whether the recited "threshold values" can include values corresponding to GPS signal levels. As explained above, even though "power level" must include "threshold values," the terms are not synonymous and there is nothing in the claims excluding "threshold values" from corresponding to GPS signal levels—in fact, the intrinsic record supports the opposite. *Supra* pp. 25-29.

In any event, *Chicago Board* addressed distinct circumstances, where the patentee argued that the terms "store," "apply," and "contain" had similar meanings even though "[n]othing in the [p]atent suggest[ed]" the terms were "used interchangeably," and the terms instead were treated differently throughout the specification. 677 F.3d 1361, 1368-69 (Fed. Cir. 2012). Here, in contrast, the term

"threshold value" appears just twice in the specification: once in relation to GPS signal levels and once in relation to battery power levels. Appx51 (7:55-59); Appx54 (13:58-67). And the term is treated the same in both instances as a user-adjustable value that determines whether location tracking circuitry is activated or deactivated. *See infra* pp. 31-42.

Thus, the Board erred in its attempt to differentiate between "signal levels" and "power level," which ultimately did not answer the relevant question of what the term "threshold values" includes.

3. Finally, the Board suggested its construction is consistent with the "purpose of the 'multitude of threshold values,' which is 'to intermittently activate or deactivate the location tracking circuitry to conserve power of the charging unit in response to the estimated charge level of the charging unit.'" Appx16 (quoting Appx55 (claim 8)). As discussed above and further detailed below, however, the claims and specification directly link GPS "signal level" values to a user's ability to activate or deactivate location tracking circuitry to conserve battery life. *See infra* pp. 34-42. Thus, the claims' "purpose" (Appx16) applies equally to "threshold values" corresponding to both GPS signal levels and battery power levels.

II. The Board's Construction Improperly Omits One of the Specification's Two Embodiments of "Threshold Values"

In addition to having no support in the claim language, the Board's construction violates this Court's directive that "absent clear evidence to the

contrary," claims should not be interpreted "in a way that would omit a disclosed embodiment." *Apple*, 81 F.4th at 1359. This Court has made clear "the specification 'is always highly relevant to the claim construction analysis. Usually, it is dispositive; it is the single best guide to the meaning of a disputed term.'" *Phillips v. AWH Corp.*, 415 F.3d 1303, 1315 (Fed. Cir. 2005) (quoting *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996)).

Here, the Board recognized the specification uses the term "threshold value" in conjunction with GPS signal levels, and that Figure 3 illustrates the process of activating or deactivating location tracking circuitry based on the power of a GPS signal—all of which tracks the claim language. Appx17-18. The Board nevertheless excluded this embodiment in its construction, which was error. *Id.* *Apple*, 81 F.4th at 1359 (reversing construction that "would exclude various embodiments disclosed by the specification"); *Google*, 92 F.4th at 1058 ("[T]he Board's claim construction excluding … an embodiment is incorrect.").

1. The Board addressed the specification's two references to a "threshold value," but accepted only one as within the scope of the claims without any principled basis. Appx16-19.

Battery Power or Charge Level Threshold Embodiment. The Board held, and the parties agree, that "threshold values" encompass the specification's embodiment concerning battery power or charge level threshold values, including

Figure 4. Appx16-17. In its decision, the Board first referred to the specification's passage tying "threshold values" to "battery power level[s]," which states that the invention "has the capability of power level (e.g. battery power level 406) adjustments [that] include [a] multitude of threshold values (see active display 432 of FIG. 4) that is determined by [the] user or system administrator to intermittently activate or deactivate location tracking circuitry" to "conserve power of the power charging unit (e.g. battery 118)." *Id.* (quoting Appx54 (13:52-67)). The Board held this language "directly links the 'multitude of threshold values' with battery power level 406" and with the "user adjustable" embodiment described in Figure 4 below. Appx17; Appx44 (Fig. 4).

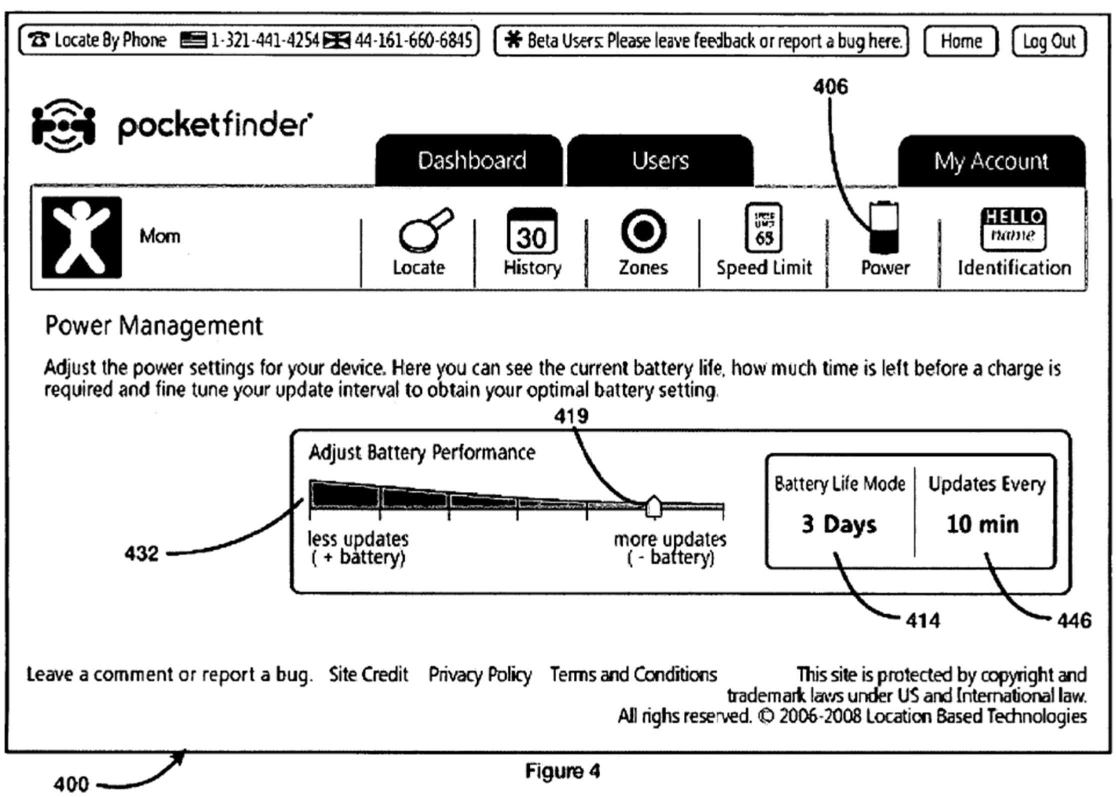

Figure 4

Figure 4 "illustrates a screen display" with a "user adjustable cursor display" that a user can adjust to cause the battery power monitor on the tracking device to "intermittently activate or deactivate location tracking circuitry," and thus "conserve power of the power charging unit." Appx50 (5:5-7); Appx54 (13:12-17); *id.* (13:52-67). The specification explains the user can adjust the slider on the display to the user's desired value depending on the frequency with which the user would like to receive location updates (at the expense of consuming battery power) or vice versa. Appx53 (11:44-67). The specification states the user can view the "real-time trade-off relationships between remaining battery charge level 414 and update rate 446 (e.g., refresh rate) of location coordinate packets" in the GPS signals, and can adjust the "slider 432" "to achieve a desired user defined battery operating environment, e.g., obtain optimal battery life, obtain optimal update rate, tradeoffs between them." *Id.* Thus, the specification describes these user-adjustable values illustrated at 419 as corresponding to an estimated charge level 414. Appx54 (13:13-30); *id.* (13:52-67).

GPS Signal Level Threshold Embodiment. The other "threshold values" embodiment, which employs GPS signal level thresholds, functions in precisely the same manner as the battery power level threshold embodiment discussed above—except that GPS signal level thresholds are the user-adjustable values instead of battery power or charge levels. Yet, the Board reached the opposite conclusion for

this GPS signal level embodiment, concluding the disclosure of "threshold value" in conjunction with a "low signal level" "does not tie embodiments pertaining to a signal level, such as the one described in Figure 3, to the recitation 'the power level comprising a multitude of threshold values.'" Appx17-18. But the Board never explained why Figure 3 was distinct from the battery power level embodiment that it concluded is encompassed by the claims. Rather, the Board appeared to assume the singular use of "threshold value" when described with reference to a GPS signal level could not equate to the plural use of "a multitude of threshold values." Appx18. The use of the singular form of a claim term, however, does not suggest a different meaning for that term when its plural form is used elsewhere. *Phillips*, 415 F.3d at 1314 (recognizing that "claim terms are normally used consistently throughout the patent"); *Paragon Sols., LLC v. Timex Corp.*, 566 F.3d 1075, 1087 (Fed. Cir. 2009) (holding that the term "unit" should be construed consistently across claim terms to allow both a "data acquisition unit" and a "display unit" to consist of multiple structures).

In any event, there is no support for the Board's arbitrary distinction between the specification's two embodiments describing "threshold values." The specification describes GPS signal levels as associated with user-adjustable values that can be used to strike the desired tradeoff between a device's location-tracking accuracy and frequency and its battery life in precisely the same manner as the

battery levels in Figure 4. *E.g.*, Appx51-52 (8:67-9:17) (describing embodiment that "conserves battery power by placing on standby, low power mode, or disabling entirely GPS signal acquisition circuitry" "when GPS signaling is not practicable"); Appx51 (8:4-16) ("location tracking circuitry 114, may be placed in a sleep or standby mode to conserve a battery level of the battery" by "periodically check[ing] availability of GPS signal, e.g., performs a GPS signal acquisition to determine if a receive communication signal is above a first signal level"); Appx52 (10:38-52) ("battery conservation for [an] electronic tracking device" may be accomplished by "activat[ing] an accelerometer if a power level of the receive communication signal is insufficient for processing").

The first instance of "threshold value" in the specification (at column 7) reads:

> In one embodiment, the accelerometer 130 activates upon one or more designated antenna(s), e.g., antennas 122*a*, 122*b*, detecting a first signal level, e.g., **a low signal level or threshold value**, as specified by, for instance, a user or system administrator.

Appx51 (7:55-59) (emphasis added). As with the discussion of "threshold values" tied to *battery* levels in column 13 (which the Board recognized was linked to the claim language and therefore supported its construction, Appx16-17), the "threshold value" described in column 7 is an example of a "signal level" that can be "specified by, for instance, a user or system administrator" in order to, *e.g.*, "con[s]er[v]e a battery level of the battery." Appx51 (7:50-8:3).

In addition, as with Figure 4, Figure 3 describes that a tracking device's location tracking circuitry is activated or deactivated in response to a threshold value associated with a particular power level (here, a GPS signal level, as opposed to a battery power level described in Figure 4, *supra* pp. 32-34). Appx43 (Fig. 3); *see also* Appx52 (10:38-67) (describing the activation and deactivation of location tracking circuitry in response to the strength of "a power level of the receive communication signal"). Specifically, Figure 3 is a "flow chart" that "illustrates battery conservation for electronic tracking device[s]" (Appx52 (10:38-41)), and allows the user to "manage and control circuitry associated with the electronic device" (Appx50 (5:1-4)).

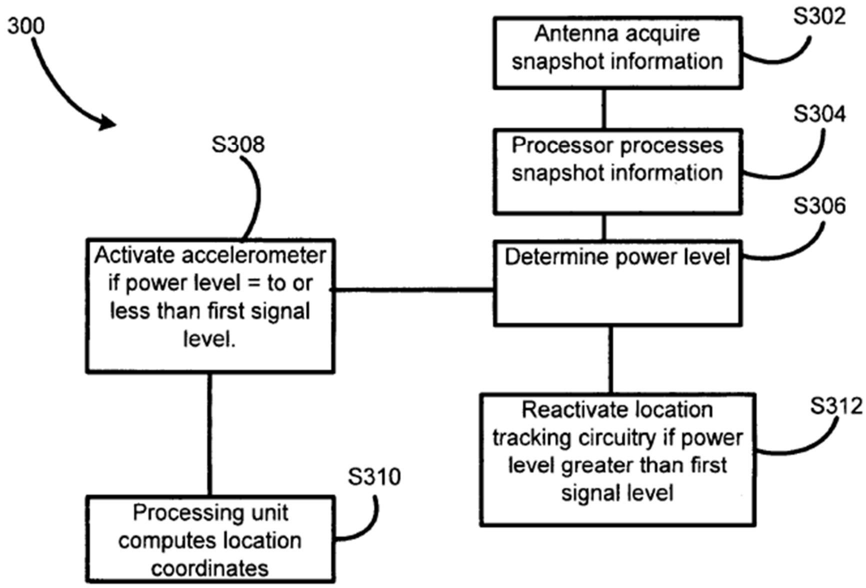

Figure 3

Appx43 (Fig. 3). The specification explains that the "antenna" in box S302 acquires "a snapshot of receive[d] communication signal including location coordinates data," *i.e.*, a GPS signal. Appx52 (10:38-52); Appx43 (Fig. 3). Then, at step S306, the processing unit "determines a power level of [the] receive[d] communication signal." Appx52 (10:38-52); Appx43 (Fig. 3). At this point, one of two actions (shown in boxes S308 and S312) is taken depending on the "power level" of the "communication signal." Appx52 (10:38-52); Appx43 (Fig. 3). If, as in box S308, the power level of the signal is "[equal] to or less than [a] first signal level" (*i.e.*, "insufficient for processing"), the device activates the accelerometer for location

tracking, rather than continuing to use the more power intensive location tracking circuitry. Appx43 (Fig. 3); Appx52 (10:38-58). On the other hand, if (as shown in box S312) the "power level [is] greater than [the] first signal level" (*i.e.*, if the GPS communication is of "sufficient signal strength"), the "location tracking circuitry" is reactivated. Appx43 (Fig. 3); Appx52 (10:38-67). Figure 3, and specifically boxes S308 and S312, thus recognize that a "power level" can be "equal to" a signal level and that, accordingly, quantifiable values associated with signal level threshold values can dictate the "power level" applied to location tracking circuitry.

Taken together, these disclosures in the specification describe a system for activating or deactivating location tracking circuitry in a tracking device based on the "power level" of a GPS signal, *i.e.*, "signal level," in the same manner Figure 4 describes such a system based on the "power level" of the device's battery, *i.e.*, "battery power level."[3] *Compare* Appx43 (Fig. 3); Appx52 (10:38-67), *with* Appx44 (Fig. 4); Appx53 (11:44-67). The Board thus erred by omitting from its construction Figure 3's embodiment that includes GPS signal level "threshold values." *Apple*, 81 F.4th at 1359; *Google*, 92 F.4th at 1058.

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[3] As discussed above, *see supra* pp. 26-29, this passage and Figure 3 also confirm that a "power level" (as used in claim 8) and "signal level" are not mutually exclusive—the GPS signal has its own "power level" that indicates the strength of the signal received by the GPS signal antennas. Appx43 (Fig. 3); Appx52 (10:38-67).

2. The remainder of the specification only further supports that the term "threshold values" includes values corresponding to GPS signal levels. For instance, the specification states the "threshold value" associated with the "signal level" can be "specified by, for instance, a user or system administrator" who can "activate[] the accelerometer" or place the location circuitry "on standby or in a sleep mode" to conserve battery. Appx51 (7:50-8:3). This disclosure closely tracks the claim language requiring that "threshold values" be determined by a user and used to activate or deactivate location tracking circuitry in response to the power or charge level of the battery. Appx55 (claim 8). The specification also refers to a "signal power level" (Appx51 (7:22-25)) and to the "power level of [a] receive communication signal" (Appx52 (10:46-47)), which is only further evidence that "power levels" can encompass GPS signal levels.

In addition, the specification repeatedly instructs that activating an accelerometer or reducing the frequency with which the GPS tracking device searches for GPS signals when those signals are low can help conserve battery, allowing a user to select a signal level at which the device switches from using the GPS to using an accelerometer to track location. Appx51 (7:50-8:3) (users can "con[s]er[v]e a battery level of the battery" by "activat[ing] the accelerometer"); Appx51 (8:7-16) (tracking device can "periodically check[] availability of GPS signal" and "may resume GPS signal acquisition using GPS satellite" when a

"receive communication signal level [is] above a first signal level"); Appx51-52 (8:67-9:3) (invention "conserves battery power by placing on standby, low power mode, or disabling entirely GPS signal acquisition circuitry and other associated devices"). Accordingly, "[t]hese disclosures make clear that the crux of the invention" is allowing users to manipulate their electronic devices to strike the user's desired tradeoff between frequent location tracking and prolonged battery life, which "supports an interpretation" of "threshold values" that allows the user to activate the location tracking circuitry based on either GPS signal strength or battery charge level. *Seabed*, 8 F.4th at 1288 (reversing the Board's claim construction where it was not supported by the "crux of the invention" set forth in the specification).

Nonetheless, relying on *Pacing Technologies, LLC v. Garmin International, Inc.*, the Board held that the "mere use of the word 'threshold' in th[e] context" of signal levels was insufficient to impart a broader interpretation to "threshold values" because "every claim does not need to cover every embodiment." Appx17-19 (n.10) (quoting 778 F.3d 1021, 1026 (Fed. Cir. 2015)). In *Pacing Technologies*, however, this Court held it was "not clear that [the] construction exclude[d]" the disputed embodiment and, even if it did, the construction was proper in view of the specification's "clear and unmistakable disavowal" of the alternative construction. 778 F.3d at 1026. The Board also relied on *AllVoice Computing PLC v. Nuance Communications, Inc.* (Appx19 (n.10)), but there the Court rejected an argument that

a claim "implicitly" included a limitation that was present in other claims. 504 F.3d 1236, 1248 (Fed. Cir. 2007). Here, by contrast, neither the specification nor any of the appealed claims excludes GPS signal levels from the scope of "threshold values." *Cf. Evolusion*, 22 F.4th at 1367 ("The specification nowhere limits the scope of a 'magazine catch bar' to exclude factory-installed ones[.]"). Thus, the Board's construction excluding one of the only two embodiments describing the term was reversible error.

III. The Prosecution History Does Not Compel a Different Conclusion

The Board further erred in agreeing with LBT that certain claims submitted and later amended during prosecution "provide[] some support" for a construction of "threshold values" that excludes GPS signal level values. Appx21. "[B]ecause the prosecution history represents an ongoing negotiation between the PTO and the applicant, rather than the final product of that negotiation, it often lacks the clarity of the specification and thus is less useful for claim construction purposes." *Phillips*, 415 F.3d at 1317. Thus, only a "clear and unmistakable" disclaimer or surrender of claim scope can overcome a contrary construction dictated by the claim language or specification. *Comcast IP Holdings I LLC v. Sprint Commc'ns Co., L.P.*, 850 F.3d 1302, 1313 (Fed. Cir. 2017) (quoting *Omega Eng'g, Inc. v. Raytek Corp.*, 334 F.3d 1314, 1325-26 (Fed. Cir. 2003)).

In its opening claim construction brief on remand, LBT cited a claim amendment from the prosecution history as evidence that the "multitude of threshold values" limitation must exclude threshold values corresponding to GPS signal levels. Appx687. LBT argued the "multitude of threshold value[s]" language first appeared in a dependent claim submitted during prosecution (prosecution claim 17) that "corresponds to the embodiment in Figure 4" concerning battery power threshold values (Appx20; Appx687; Appx717):

> wherein the power level comprises a multitude of threshold value[s] determined by a user or system administrator to intermittently activate or deactivate the location tracking circuitry to conserve power of the power charging unit in response to the estimated charge level of the power unit.

Appx687 (quoting Appx2456) (emphasis omitted). LBT then pointed to a second dependent claim from the prosecution (prosecution claim 16) (Appx717) that added:

> wherein the power charging monitor measures a power level of the power charging unit and adjusts a power level applied to the location tracking circuitry responsive to the signal level.

Appx2456. LBT argued that prosecution claim 16 "corresponds to the signal level embodiment of Figure 3" and therefore is distinct from prosecution claim 17. Appx20 (citing Appx719).

Specifically, LBT contended that prosecution claim 17 was intended to "correspond[] to the embodiment of" Figure 4 (Appx717) because the claim included the limitation "the power level comprises a multitude of threshold values,"

and specified that these threshold values were used to "intermittently activate or deactivate the location tracking circuitry"—which, LBT argued, follows the language used in the specification to describe Figure 4. Appx687 (citing Appx2456; Appx53 (11:44-67)). LBT argued that, by contrast, prosecution claim 16, which did not use the phrase "threshold values" but referred to "location tracking circuitry responsive to one or more signal levels," was a "distinct dependent claim" during prosecution and thus could not encompass the battery power level "threshold values" in claim 17. Appx717-719; *see also* Appx2456. The Board agreed that LBT's argument and the "delineation" between the two prosecution claims "provides some support" for a construction of "threshold values" excluding GPS signal level values. Appx21.

The Board's agreement with LBT's argument, which lacked any further explanation, was error. Nothing in the language of either prosecution claim prohibits "threshold values" from encompassing GPS signal levels; indeed, as discussed, the specification ties "threshold value" to both power levels and signal levels, so the mere use of "signal levels" in a separate prosecution claim does not amount to a disclaimer excluding GPS "signal levels" from the definition of "threshold values." *See supra* pp. 31-42. Further, other prosecution claims, *e.g.*, prosecution claim 9, refer to a "charge level" on a "user adjustable cursor display," but make no reference

to "threshold values." Appx2455. Yet, both parties agree that these charge levels may represent threshold values within the meaning of the claims.

In addition, neither the applicant nor the Patent Office suggested the use of "threshold values" in prosecution claim 17 carried any particular significance or served to limit the scope of the claim term. *See* Appx997-1000; Appx1016-1026. Instead, the Patent Office simply denied prosecution claim 16 as anticipated and objected to claim 17 as dependent on a rejected claim. Appx997-999. The applicant amended the claims to combine prosecution claims 16 and 17 "without commenting on the propriety of the rejection" (Appx1024-1026), and the claims were then allowed (Appx1030-1034). Neither the applicant nor the Patent Office "made any particular remarks regarding the differences" between power levels and signal levels, nor any remarks on the scope of "threshold values," and therefore did nothing "clear or unambiguous to disclaim claim scope otherwise encompassed by the broadly drafted claims." *Plantronics, Inc. v. Aliph, Inc.*, 724 F.3d 1343, 1351 (Fed. Cir. 2013) (holding that an exchange with the Patent Office about which claims to elect did not amount to disclaimer).

Thus, because there was no clear and unmistakable disavowal of claim scope, the Board was incorrect to conclude that the "delineation" between the two claims supported its construction. Appx21. That two prosecution claims were different from each other does not shed light on the meaning of "threshold values," nor does

amending claim language by itself evince a clear intention by the applicant to exclude the embodiments described in the specification and distinguish "threshold values" as separate from GPS signal levels. *See Kopykake Enterprises, Inc. v. Lucks Co.*, 264 F.3d 1377, 1382 (Fed. Cir. 2001) (declining to find prosecution disclaimer for "screen printing" where the prosecution history "neither defined 'screen printing' nor excluded a particular printing process from the definition of screen printing"); *Baxalta Inc. v. Genentech Inc.*, 972 F.3d 1341, 1348 (Fed. Cir. 2020) (amendment to substitute "antibody fragments" for "antibody derivatives" in claim during prosecution did not amount to the applicant disclaiming the full scope of "antibody" defined in the specification). The prosecution history therefore cannot overcome the plain language of the claims and the specification, which demonstrate that GPS signal level thresholds are within the scope of "threshold values."

CONCLUSION

The Board erred in construing "threshold values" to exclude values corresponding to GPS signal levels. Based on that incorrect construction, the Board rejected Apple's argument that the threshold values corresponding to GPS signal levels in Sakamoto constitute a "multitude of threshold values" that render the challenged claims obvious. Appx31-34. For the reasons discussed above, this Court should reverse the Board's construction, hold that "threshold values" include values associated with GPS signal levels, and remand for the Board to consider whether

claims 8, 10, 13, and 15 of the '774 patent are unpatentable as obvious under this correct construction.

Dated: July 16, 2024

Respectfully submitted,

/s/ Jaysen S. Chung

Jaysen S. Chung, *Principal Attorney*
GIBSON, DUNN & CRUTCHER LLP
One Embarcadero Center, Suite 2600
San Francisco, CA 94111
(415) 393-8271

Brian A. Rosenthal
GIBSON, DUNN & CRUTCHER LLP
200 Park Avenue
New York, NY 10166
(212) 351-2339
brosenthal@gibsondunn.com

Julia G. Tabat
GIBSON, DUNN & CRUTCHER LLP
2001 Ross Ave, Suite 2100
Dallas, TX 75201
(214) 698-3465

Counsel for Appellant Apple Inc.

ADDENDUM

Table of Contents

Trials@uspto.gov
571-272-7822

Paper 48
Entered: December 15, 2023

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

LBT IP I LLC,
Patent Owner.

IPR2020-01189
Patent 8,497,774 B2

Before JOHN A. HUDALLA, SHEILA F. McSHANE, and JULIET MITCHELL DIRBA, *Administrative Patent Judges*.

HUDALLA, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision on Remand
Determining No Remaining Challenged Claims Unpatentable
35 U.S.C. §§ 144, 318(a)

I. INTRODUCTION

This Remand Decision is a final written decision on remand from the United States Court of Appeals for the Federal Circuit, which vacated and remanded certain parts of our original Final Written Decision (Paper 39, "Final Dec.") in this *inter partes* review. *See LBT IP I LLC v. Apple Inc.*,

No. 2022-1613, 2023 WL 3914920 (Fed. Cir. June 9, 2023).[1] In particular, the Federal Circuit vacated and remanded our obviousness determinations with respect to claims 8, 10, 13, and 15 of U.S. Patent No. 8,497,774 B2 (Ex. 1001, "the '774 patent"). Paper 42, 13.

We have jurisdiction under 35 U.S.C. § 6, and we issue this Final Written Decision on Remand under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons discussed below, Apple Inc. ("Petitioner") has not demonstrated by a preponderance of the evidence that remaining challenged claims 8, 10, 13, and 15 of the '774 patent are unpatentable.

A. Background

Petitioner filed a Petition (Paper 1, "Pet.") requesting an *inter partes* review of claims 1, 4–6, 8, 10, 13, and 15 ("the challenged claims") of the '774 patent. LBT IP I LLC ("Patent Owner") filed a Preliminary Response. Paper 8. Taking into account the arguments presented in Patent Owner's Preliminary Response, we determined that the information presented in the Petition established that there was a reasonable likelihood that Petitioner would prevail with respect to its unpatentability challenges. Pursuant to 35 U.S.C. § 314, we instituted this proceeding on March 4, 2021, as to all challenged claims and all asserted grounds of unpatentability, which are reproduced below (Paper 9 ("Dec. on Inst.")):

[1] A copy of the Federal Circuit's decision has been entered as Paper 42, to which we will refer hereinafter.

Claims Challenged	35 U.S.C. §	References/Basis
1, 4–6, 8, 10, 13, 15	103(a)[2]	Sakamoto[3]
1, 4–6, 8, 10, 13, 15	103(a)	Sakamoto, AAPA[4]
1, 4–6, 8, 10, 13, 15	103(a)	Sakamoto, Hayasaka[5]

During the course of trial, Patent Owner filed a Patent Owner Response (Paper 17, "PO Resp."), and Petitioner filed a Reply to the Patent Owner Response (Paper 25, "Pet. Reply"). Patent Owner also filed a Sur-reply.[6] Paper 31 ("PO Sur-reply").

Petitioner filed Declarations of Scott Andrews with its Petition (Ex. 1003) and with its Reply (Ex. 1077). Both parties filed a transcript of the deposition of Mr. Andrews. Exs. 1068, 2003.

An oral hearing was held on December 8, 2021, and a transcript of the hearing is included in the record. Paper 38 ("Tr.").

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[2] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. §§ 102, 103, and 112. Because the application leading to the '774 patent was filed before March 16, 2013 (the effective date of the relevant amendments), the pre-AIA versions of §§ 102 and 103 apply.

[3] Japanese Unexamined Patent Application Publication No. JP 2004-37116A, published Feb. 5, 2004 (Ex. 1004, "Sakamoto"). Sakamoto is a Japanese-language publication (Ex. 1004, 36–49, 58) that was filed with an English-language translation (*id.* at 1–19, 21–34, 52–56) and declarations attesting to the accuracy of the translation (*id.* at 20, 50). Our citations to Sakamoto herein refer to the translation.

[4] Applicants' Admitted Prior Art (Ex. 1001, 11:22–30, "AAPA").

[5] U.S. Patent No. 5,845,142, filed Aug. 29, 1997, issued Dec. 1, 1998 (Ex. 1011, "Hayasaka").

[6] The parties also filed papers related to Patent Owner's motion to amend, but the motion to amend is not within the scope of the instant remand.

We issued a Final Written Decision determining, *inter alia*, that Petitioner demonstrated by a preponderance of the evidence that claims 1, 4–6, 8, 10, 13, and 15 of the '774 patent are unpatentable. Final Dec. 68. As part of our analysis for claims 8, 10, 13, and 15, we determined that the term "multitude" in the recited "multitude of threshold values" of claim 8 may include two threshold values. *Id.* at 12–18. We applied this interpretation as part of our determination that claims 8, 10, 13, and 15 would have been obvious over Sakamoto under 35 U.S.C. § 103(a). *Id.* at 37–44.

On June 9, 2023, the Federal Circuit issued an opinion vacating and remanding our obviousness determinations with respect to claims 8, 10, 13, and 15 of the '774 patent.[7] Paper 42, 13. The court's decision was based on its construction of "multitude of threshold values" in the following limitation of claim 8:

> wherein the battery power level monitor measures a power level of the charging unit and adjusts a power level applied to location tracking circuitry responsive to one or more signal levels, the power level comprising a *multitude of threshold values* determined by a user or system administrator to intermittently activate or deactivate the location tracking circuitry to conserve power of the charging unit in response to the estimated charge level of the charging unit.

Ex. 1001, 16:53–61 (emphasis added). The court stated that "[t]he plain and ordinary meaning of multitude in the '774 patent does not encompass two threshold values." Paper 42, 11. Further clarifying its construction, the court stated that "[w]e hold only that multitude does not include two but

[7] Patent Owner did not appeal our obviousness determinations regarding claims 1 and 4–6 or our denial of Patent Owner's motion to amend. *See* Paper 42, 9.

must include as few as five threshold values." *Id.* at 13. Thus, the court vacated our determination that Sakamoto's two battery power level thresholds teach the claimed "multitude of threshold values." *Id.*

The court also noted that we did not address Petitioner's alternative argument that Sakamoto teaches at least four threshold values—two battery level thresholds and two GPS signal level thresholds. Paper 42, 13. Accordingly, the court remanded this case to us to determine "whether multitude encompasses three or four threshold values and whether the two sets of threshold values disclosed in Sakamoto teach a multitude of threshold values." *Id.*

On remand, we asked the parties to brief whether—as a matter of claim construction—the "threshold values" in the recited "multitude of threshold values" of claim 8 are limited to battery power level threshold values or whether they may also include signal level threshold values. Paper 43, 3. Petitioner filed an opening brief (Paper 45, "Pet. Remand Br.") and a responsive brief (Paper 46, "Pet. Remand Resp."). In parallel, Patent Owner also filed an opening brief (Paper 44, "PO Remand Br.") and a responsive brief (Paper 47, "PO Remand Resp.").

B. The '774 patent

The '774 patent is directed to location and tracking communication systems. Ex. 1001, 1:33–34. Figure 1 of the '774 patent is reproduced below.

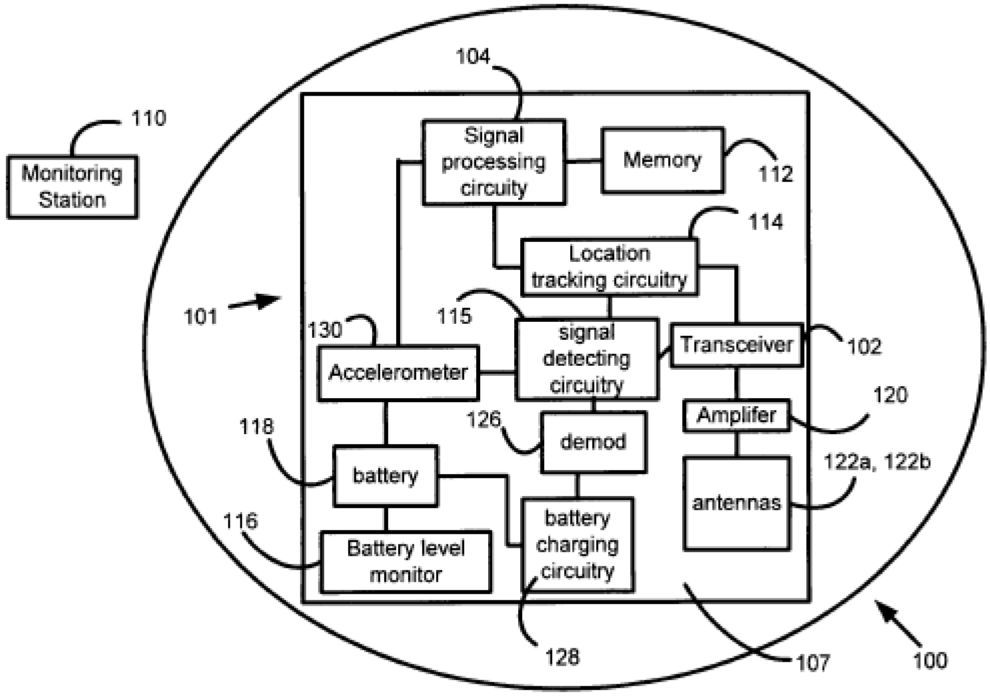

Figure 1

Figure 1 depicts a schematic of tracking device 100, which contains electronic components 101 such as transceiver 102, signal processing circuitry 104 (e.g., a microprocessor or other signal logic circuitry), and accelerometer 130. *Id.* at 4:62–64, 6:54–57. Location tracking circuitry 114 (e.g., global positioning system (GPS) circuitry) calculates location data received and sends the data to signal processing circuitry 104. *Id.* at 7:17–19. Signal detecting circuitry 115 detects and measures signal power level. *Id.* at 7:22–23. Battery level monitor 116 detects a battery level of battery 118. *Id.* at 7:25–28.

Tracking device 100 periodically checks availability of a GPS signal by performing a GPS signal acquisition to determine if a receive communication signal is above a first signal level. *Id.* at 8:7–10. Location tracking circuitry 114 or transceiver 102 may be placed in a sleep or standby mode to conserve a battery level of battery 118. *Id.* at 8:4–8. Electronic

tracking device 100 may resume GPS signal acquisition using GPS satellites when the acquired receive communication signal level is above the first signal level. *Id.* at 8:10–16.

Accelerometer 130 may also activate if a power level of the receive communication signal (e.g., GPS signal) is insufficient for processing. *Id.* at 10:47–49. In this case, processing unit 104 computes current location coordinates using acceleration measurements. *Id.* at 10:53–54. When the receive communication signal again becomes sufficient for processing, accelerometer 130 is deactivated and location tracking circuitry 114 is activated. *Id.* at 10:58–67. In this case, processing unit 104 resumes the calculation of location coordinates from the receive communication signal. *Id.*

Figure 4 of the '774 patent is reproduced below.

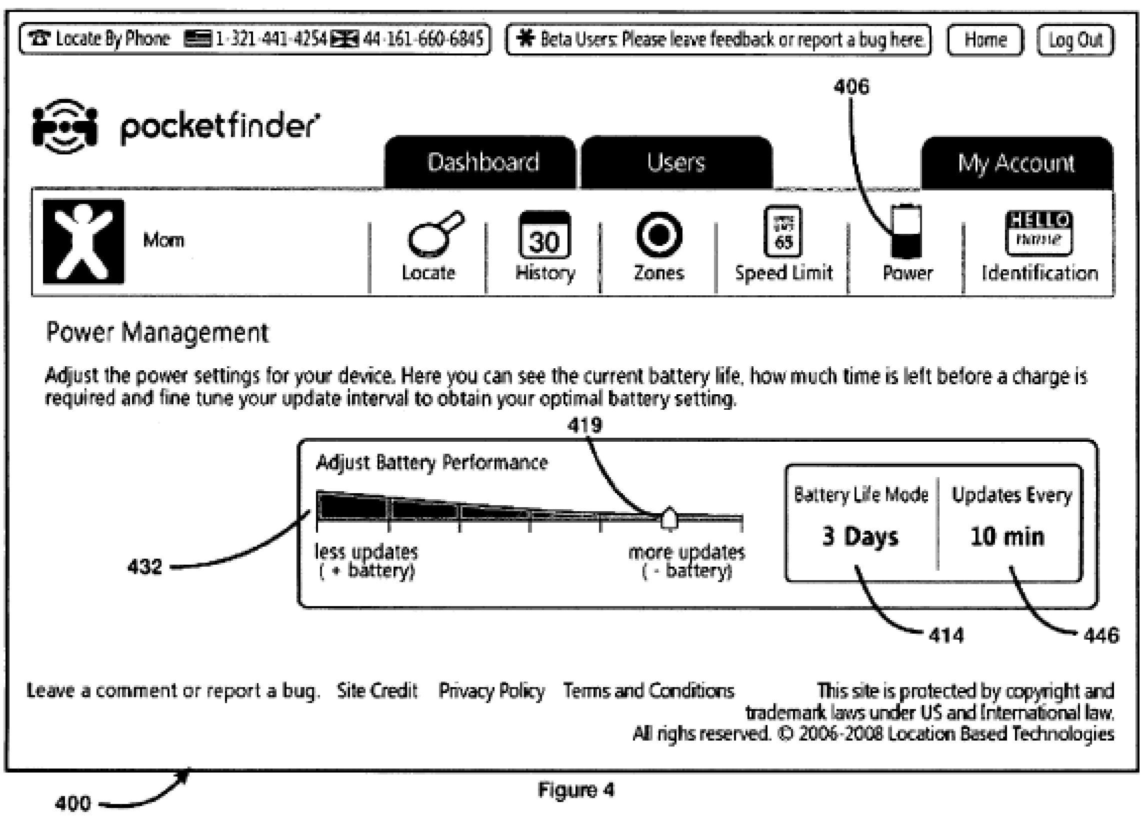

Figure 4

Figure 4, above, depicts screen display 400 of a personal communication device including a user definable adjustable power level monitor for an electronic tracking device. *Id.* at 5:5–7, 11:2–4, 11:12–17. Battery level monitor 116 measures in real-time battery charge level 406 of battery 118 and predicts estimated remaining battery charge life 414 in response to battery charge level 406. *Id.* at 11:22–25, 13:52–58. Battery level monitor 116 also adjusts the power level applied to location tracking circuitry 114 or transceiver 102 responsive to one or more signal levels. *Id.* at 13:52–58.

A local battery power adjustment mechanism generates in substantially real-time an updated set of network communication signaling protocols including, for example, update rate 446 (e.g., refresh rate) of location coordinate packets. *Id.* at 11:31–36. Update rate 446 consists of a request rate of location coordinate packets by the target host and/or a listen rate of location coordinate packets by the portable electronic tracking device. *Id.* at 11:36–41. The local battery power adjustment mechanism includes user-adjustable slider 432[8] to graphically display in substantially real-time the trade-off relationships between remaining battery charge level 414 and update rate 446 of location coordinate packets. *Id.* at 11:53–57. The user may select a multitude of threshold values via slider 432 to intermittently activate or deactivate location tracking circuitry 114 in order to conserve the power of battery 118. *Id.* at 13:58–67. For example, the user may adjust slider 432 to choose a range of values between a lower update rate 446 (and

[8] Slider 432 is also called "user adjustable screen icon 432," "on-line user adjustable cursor display 432," and "active display 432" in the Specification of the '774 patent. *See, e.g.*, Ex. 1001, 11:53–57, 13:13–18, 13:58–67.

less battery usage) and a higher update rate 446 (and more battery usage). *Id.* at 11:53–57, Fig. 4. This results in "an appropriate update[d] set of network communication signaling protocols to achieve a desired user defined battery operating environment, e.g., obtain optimal battery life, obtain optimal update rate, [and the] tradeoffs between them." *Id.* at 11:58–63. This further may result in the local battery power adjustment mechanism communicating a message to activate or deactivate a portion of the transceiver circuitry, processor circuitry, or location tracking circuitry. *Id.* at 11:44–53.

The '774 patent issued from Application No. 12/419,451 filed on April 7, 2009, which is a continuation-in-part of six applications. Ex. 1001, codes (21), (63).

C. Illustrative Claim

Of the remaining claims of the '774 patent, claim 8 is independent. Claims 10, 13, and 15 depend from claim 8. Claim 8 is illustrative of the remaining claims and recites:

> 8. A local charging management device to manage electrical resource capability for an electronic tracking device that is tracked by at least one other tracking device comprising:
>
> a battery power level monitor;
>
> a charging unit; and
>
> an electrical power resource management component to adjust cycle timing of at least one of a request rate of location coordinate packets to a target host and a listen rate of the location coordinate packets responsive to an estimated charge level of the charging unit,
>
> wherein the battery power level monitor measures a power level of the charging unit and adjusts a power level

> applied to location tracking circuitry responsive to one or more signal levels, the power level comprising a multitude of threshold values determined by a user or system administrator to intermittently activate or deactivate the location tracking circuitry to conserve power of the charging unit in response to the estimated charge level of the charging unit.

Ex. 1001, 16:43–61.

D. Remaining Challenged Claims and Grounds

We address below the remaining grounds at issue in this Remand Final Written Decision, which are summarized in the following table (Pet. 6; Dec. on Inst. 29; Paper 42, 17):

Claims Challenged	35 U.S.C. §	References/Basis
8, 10, 13, 15	103(a)	Sakamoto
8, 10, 13, 15	103(a)	Sakamoto, AAPA
8, 10, 13, 15	103(a)	Sakamoto, Hayasaka

II. ANALYSIS

A. Legal Standards

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, so-called secondary

considerations.[9] *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). We also recognize that prior art references must be "considered together with the knowledge of one of ordinary skill in the pertinent art." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994) (citing *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)).

B. Level of Ordinary Skill in the Art

For the same reasons discussed in our original Final Written Decision, we apply the following level of ordinary skill in the art: A person of ordinary skill in the art (or "POSITA") would have had a bachelor's degree in Electrical Engineering, Computer Engineering, Computer Science, or an equivalent degree, with two years of experience in GPS navigation, portable tracking devices, or related technologies. Final Dec. 10–11.

C. Claim Interpretation

In an *inter partes* review, we construe each claim

> using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. [§] 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.

37 C.F.R. § 42.100(b). Accordingly, our claim construction standard is the same as that of a district court. *See id.* Under the standard applied by district courts, claim terms are generally given their plain and ordinary meaning as would have been understood by a person of ordinary skill in the

[9] The trial record does not include any evidence of secondary considerations of nonobviousness.

art at the time of the invention and in the context of the entire patent disclosure. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005) (en banc). "There are only two exceptions to this general rule: 1) when a patentee sets out a definition and acts as his own lexicographer, or 2) when the patentee disavows the full scope of a claim term either in the specification or during prosecution." *Thorner v. Sony Comput. Entm't Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012).

1. "Multitude"

As discussed above, the Federal Circuit held that "[t]he plain and ordinary meaning of multitude in the '774 patent does not encompass two threshold values." Paper 42, 11. The court also stated that "multitude does not include two but must include as few as five threshold values." *Id.* at 13. Thus, based on the court's holding, a "multitude" cannot be two threshold values. *Id.* at 11, 13. Although the court left open the question of whether a "multitude" encompasses three or four threshold values, we do not need to answer this question to dispose of the remaining claims and grounds. *See, e.g.*, *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) ("The Board is required to construe 'only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.'" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

2. "The power level comprising a multitude of threshold values"

In briefing on remand, the parties addressed the construction of "multitude of threshold values" in the following limitation from claim 8:

> wherein the battery power level monitor measures a power level of the charging unit and adjusts a power level applied to location tracking circuitry responsive to one or more signal levels, the power level comprising a *multitude of threshold values* determined by a user or system administrator to intermittently activate or deactivate the location tracking circuitry to conserve power of the charging unit in response to the estimated charge level of the charging unit.

Ex. 1001, 16:53–61 (emphasis added). In particular, the parties addressed whether—as a matter of claim construction—the "threshold values" in the recited "multitude of threshold values" are limited to battery power level threshold values or whether they may also include signal level threshold values. *See* Paper 43, 3.

Petitioner argues that "any construction of 'threshold values' must include *both* battery power *and* GPS signal level threshold values." Pet. Remand Br. 1. Petitioner notes that the '774 patent discloses an embodiment where a GPS signal level is related to a threshold value. *Id.* (quoting Ex. 1001, 7:55–59). Petitioner explains how the system of the '774 patent attempts to save battery power by deactivating the GPS when GPS signal levels reach a GPS signal level threshold, i.e., "they are too weak." *Id.* at 2 (citing Ex. 1001, 3:2–7, 7:55–8:3, 8:7–16, 8:67–9:3). Petitioner further explains that the GPS signal level threshold is used to determine whether to activate or deactivate accelerometer circuitry. *Id.* at 3–4 (citing Ex. 1001, 9:14–16, 10:38–52, Fig. 3). Petitioner contends that "this embodiment would be inoperable if it solely looked at a multitude of battery level thresholds" and "[a] construction of 'multitude of threshold values' that excludes GPS signal levels would read out this specific embodiment of the '774 Patent." *Id.* at 4–6. Finally, Petitioner notes that "threshold value" appears only two times in the '774 patent: once with reference to battery

power threshold levels, and another with reference to GPS signal level thresholds. *Id.* at 6–7 (citing Ex. 1001, 7:55–58, 13:58–62).

Patent Owner argues that "[t]he claim language itself . . . shows that the 'multitude of thresholds' refers to the power level that is monitored and adjusted by the battery power level monitor." PO Remand Br. 2. Patent Owner also argues that the specification of the '774 patent "repeatedly and consistently identifies the claimed power level with battery power level 406." *Id.* at 2–3 (citing Ex. 1001, 13:52–67). Patent Owner additionally argues that the specification "discloses that battery power level adjustments may be based on user input," and that "the recited 'multitude of threshold values' corresponds to value 419, which is explicitly disclosed as defining a battery power level threshold that can be adjusted to a multitude of values." *Id.* at 3–4 (citing Ex. 1001, 11:44–63, 13:58–67, Fig. 4). Patent Owner further highlights how the specification never "refers to a GPS signal level as a 'power level,' but only as a 'signal level.'" *Id.* at 4 (citing Ex. 1001, 2:64–65, 7:57–58, 8:10, 8:16, 13:58, 16:56).

In Petitioner's responsive brief, Petitioner argues that the parties' dispute is simply whether the GPS signal level embodiment is part of the claims or not. Pet. Remand Resp. 1. According to Petitioner, Patent Owner ignores the GPS signal level embodiment in Figure 3 of the '774 patent and instead focuses solely on the battery level embodiment of Figure 4. *See id.* at 1–3. Petitioner also argues that the transitional word "comprising" in "the power level comprising a multitude of threshold values" implies that the "'multitude of threshold values' may include the power level of a battery *but the claim is not limited to only those power levels*." *Id.* at 4–5 (citing *Crystal Semiconductor Corp. v. TriTech Microelectronics Intl'l, Inc.,* 246 F.3d 1336,

1362 (Fed. Cir. 2001)). As such, Petitioner contends that we should read the "broad, plain language used in claim 8" to cover both "the battery level embodiment columns 11-13, as relied upon by [Patent Owner], but also the precise GPS signal embodiment from column 7 through column 10." *Id.* at 5.

In Patent Owner's responsive brief, Patent Owner argues that Petitioner "ignores [the] clear claim language" and instead "relies on a single embodiment disclosed in the '774 Patent that is separate and distinct from the embodiment covered by Claim 8's 'multitude of threshold levels.'" PO Remand Resp. 1. According to Patent Owner, "[t]he '774 Patent discloses two distinct and complimentary embodiments that are each separately encompassed in Claim 8." *Id.* at 2. Patent Owner also disputes that the '774 patent discloses a multitude of GPS signal level thresholds because the specification only refers to a singular GPS signal level threshold value. *Id.* at 3 (citing Ex. 1001, 7:55–59). Patent Owner additionally notes that the GPS signal level embodiment of Figure 3 was originally associated with prosecution claim 16, while the magnitude of power levels embodiment of Figure 4 was originally associated with prosecution claim 17. *Id.* at 5; *see also* Ex. 2019, 372 (prosecution claims 16 and 17 as originally filed); PO Remand Br. 3 (discussion about prosecution claim 17).

To decide whether "the power level comprising a multitude of threshold values" includes GPS signal level thresholds, we start with the words of claim 8. Claim 8 recites a "battery power level monitor" that (1) "measures a power level of the charging unit" and (2) "adjusts a power level applied to location tracking circuitry responsive to one or more signal levels." Claim 8 further recites that "the power level compris[es] a

multitude of threshold values determined by a user or system administrator." The remainder of claim 8 states the purpose of the "multitude of threshold values," which is "to intermittently activate or deactivate the location tracking circuitry to conserve power of the charging unit in response to the estimated charge level of the charging unit." The natural reading of these recitations is that the "power level" associated with the "multitude of threshold values" is the battery power level that is (1) measured by the battery power level monitor and (2) adjusted by the battery power level monitor and applied to location tracking circuitry. We also note that the claim language already incorporates a limitation directed to "signal levels" insofar as the battery power level monitor "adjusts a power level applied to location tracking circuitry responsive to *one or more signal levels*" (emphasis added). As such, the limitation "one or more signal levels" is recited separately from the limitation "the power level comprising a multitude of threshold values." Given "[t]he general presumption that different terms have different meanings," *Chicago Bd. Options Exch., Inc. v. Int'l Sec. Exch., LLC*, 677 F.3d 1361, 1369 (Fed. Cir. 2012), we ascribe different meanings to the recited "signal levels" and "power level."

We next turn to the written description of the '774 patent. The only reference to a "multitude of threshold values" appears in the following paragraph:

> In yet another advantage, the present invention power charging monitor (e.g., battery level monitor 116) measures a power level (e.g., battery power level 406) of power charging unit (e.g., battery 118) and adjusts a power level (e.g., battery power level 406) applied to, for example, location tracking circuitry (e.g., location tracking circuitry 114) or transceiver 102 responsive to one or more signal levels. In contrast to previous manufacturer tracking device power level settings, the

> present invention has the capability of power level (e.g., battery power level 406) adjustments include *multitude of threshold values* (see active display 432 of FIG. 4) that is determined by user or system administrator to intermittently activate or deactivate location tracking circuitry (e.g., location tracking circuitry 114) to conserve power of the power charging unit (e.g., battery 118) responsive to estimated charge level (e.g., battery charge level 406).

Ex. 1001, 13:52–67 (emphasis added); *see* Paper 42, 11 (court pointing to Figure 4 and this passage as "[t]he only example of a multitude of threshold values provided in the specification"). Thus, the specification directly links the "multitude of threshold values" with battery power level 406. Ex. 1001, 13:52–67. It also links the "multitude of threshold values" with active display 432 in Figure 4, which is also called "slider 432," "user adjustable screen icon 432," "on-line user adjustable cursor display 432." *See id.* at 11:53–57, 13:13–18, 13:58–67. The specification states that "user adjustable electronic display 432 . . . indicates [the] current level of battery 406 and allows [the] user a capability to adjust power level thereof." Accordingly, a user may adjust screen cursor value 419 within active display 432 to choose the desired battery power threshold value among the multitude of battery power threshold values. *See id.* at 11:44–67, 13:58–67, 15:17–21, Fig. 4. Both parties acknowledge that this embodiment is within the scope of the recited "multitude of threshold values." Pet. Remand Br. 6–7; PO Remand Br. 3–4. We agree.

The written description uses the word "threshold value" in only one other passage: "In one embodiment, the accelerometer 130 activates upon one or more designated antenna(s), e.g., antennas 122 a, 122 b, detecting a first signal level, e.g., a low signal level or *threshold value*, as specified by, for instance, a user or system administrator." Ex. 1001, 7:55–59 (emphasis

added). Petitioner argues that this passage "describes an embodiment that includes GPS signal level as part of the multitude of threshold values." Pet. Remand Br. 1. Yet the mere use of the word "threshold" in this context does not tie embodiments pertaining to a signal level, such as the one described in Figure 3, to the recitation "the power level comprising a multitude of threshold levels." Furthermore, as stated above, claim 8 already includes a limitation directed to adjusting the applied power level to the location tracking circuitry "responsive to one or more signal levels," which is consistent with "the low signal level or threshold value" in this passage from the written description. *See* Ex. 1001, 16:53–61; *see also id.* at 13:52–58 ("[P]ower charging monitor (e.g., battery level monitor 116) measures a power level (e.g., battery power level 406) of power charging unit (e.g., battery 118) and adjusts a power level (e.g., battery power level 406) applied to, for example, location tracking circuitry (e.g., location tracking circuitry 114) or transceiver 102 *responsive to one or more signal levels*" (emphasis added)).

Petitioner also argues that the signal level embodiment of Figure 3 "would be inoperable if it solely looked at a multitude of battery level thresholds." Pet. Remand Br. 4–5. According to Petitioner, a construction limiting the "multitude of threshold values" to battery power thresholds would read out the Figure 3 embodiment. *Id.* at 5–6; *see also* Pet. Remand Resp. 1–7 ("The dispute is simply whether that embodiment is part of the claims or not."). We disagree. As stated above, claim 8 already recites that the battery power level monitor adjusts the battery power level "applied to location tracking circuitry *responsive to one or more signal levels*," which incorporates the notion of responding to a signal level threshold. *See*

Ex. 1001, 13:52–58, 16:53–61. Thus, we do not agree that Patent Owner's proposed construction of the "multitude of threshold values" reads out a signal level embodiment.[10] The existing "signal levels" recitation in claim 8 also undermines Petitioner's argument that Patent Owner's proposed construction would result in a system that "only looked at a multitude of battery threshold values" and could "never deactivate the GPS circuitry." Pet. Remand Br. 5.

We also have considered Petitioner's arguments that the word "comprising" in "the power level comprising a multitude of threshold values" "compels a conclusion that the 'threshold values' in claim 8 are not limited to only battery levels." Pet. Remand Resp. 4–5 (citing *Crystal Semiconductor Corp. v. TriTech Microelectronics Int'l, Inc.,* 246 F.3d 1336, 1362 (Fed. Cir. 2001); *Genentech, Inc. v. Chiron Corp.,* 112 F.3d 495, 501 (Fed. Cir. 1997)). We do not agree with the premise of Petitioner's arguments because this limitation defines what "the power level" comprises, not what "a multitude of threshold values" comprises. Thus, contrary to Petitioner's arguments, whatever follows the term "comprising" in this limitation must still be a "power level" to be within the scope of the claim. As such, "the power level comprising a multitude of threshold values" refers

[10] We further note that where, as here, "the patent describes multiple embodiments, every claim does not need to cover every embodiment." *Pacing Techs., LLC v. Garmin Int'l, Inc.*, 778 F.3d 1021, 1026 (Fed. Cir. 2015); *see also AllVoice Computing PLC v. Nuance Commc'ns, Inc.*, 504 F.3d 1236, 1248 (Fed. Cir. 2007) ("[E]very claim need not contain every feature taught in the specification."). Thus, even if claim 8 did not recite a limitation directed to a signal level threshold, the lack of such a limitation would not support Petitioner's proposed construction.

to a power level having threshold values, not something else having threshold values. We further note that Petitioner's arguments are based on case law giving "comprising" legal effect as a transitional phrase between the preamble and the body of a claim. In contrast, the word "comprising" here is in the body of the claim, so it has "no special legal effect" and "should be interpreted according to the normal rules of claim interpretation." *Moleculon Rsch. Corp. v. CBS, Inc.*, 793 F.2d 1261, 1272 n.8 (Fed. Cir. 1986). Therefore, consistent with *Moleculon*, we interpret "comprising" here as "'having' but not 'having at least.'" *Id.*

We additionally have considered the prosecution history of the '774 patent. Patent Owner notes (PO Remand Br. 3) that the "multitude of threshold values" limitation initially appeared in prosecution claim 17, which is reproduced below.

> 17. The apparatus of claim 16, wherein the power level comprises a multitude of threshold value [sic] determined by a user or system administrator to intermittently activate or deactivate the location tracking circuitry to conserve power of the power charging unit in response to the estimated charge level of the power unit.

Ex. 2019, 372. Patent Owner argues that this prosecution claim corresponds to the embodiment in Figure 4 and evidences an association between the threshold values and "turning the location tracking circuitry on and off," such that "the 'multitude of threshold values' can only be battery power level threshold values." PO Remand Br. 3 (citing Ex. 1001, 11:44–67, 12:32–49, 14:1–57, 15:4–21); PO Remand Resp. 5. Patent Owner also notes (PO Remand Resp. 5) that prosecution claim 16, which is reproduced below, corresponds to the signal level embodiment of Figure 3.

> 16. The apparatus of claim 8, wherein the power charging monitor measures a power level of the power charging unit and adjusts a power level applied to the location tracking circuitry responsive to the signal level.

Ex. 2019, 372. Petitioner does not address the prosecution history. We agree with Patent Owner that the delineation between prosecution claims 16 and 17 provides some support that the "multitude of threshold values" in issued claim 8 relates to battery power levels and not signal levels.[11]

For these reasons, we determine that the "power level" in "the power level comprising a multitude of threshold values" refers to battery power threshold values. In addition, the words of claim 8, the specification of the '774 patent, and the prosecution history all distinguish "signal levels" from battery power levels, which evidences that signal level threshold values are not within the scope of "the power level comprising a multitude of threshold values."

3. Other Terms

We determine that no other terms require explicit construction. *See Realtime Data*, 912 F.3d at 1375.

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[11] Prosecution claim 17 depended from prosecution claim 16, which in turn depended from independent prosecution claim 8. *See* Ex. 2019, 370, 372. The Examiner objected to prosecution claim 17 as being dependent upon a rejected base claim, but indicated that it would be allowable if rewritten in independent form including all of the limitations of the base claim and the intervening claim. *Id.* at 107. Accordingly, the patentees amended prosecution claim 8 to include the limitations of prosecution claims 16 and 17. *Id.* at 93–94, 98–99. The amended prosecution claim 8 issued as claim 8 in the '774 patent.

D. Obviousness Ground Based on Sakamoto

Petitioner contends the subject matter of claims 8, 10, 13, and 15 would have been obvious over Sakamoto. Pet. 44–55; Pet. Reply 15–19. Patent Owner disputes Petitioner's contentions. PO Resp. 10–17; PO Sur-reply 11–14.

1. Sakamoto

Sakamoto is a Japanese patent application publication directed to the use of a GPS positioning system that includes a portable terminal and remote server. Ex. 1004, code (57), ¶ 18. Figure 1, reproduced below, is a diagram showing a position information communication terminal.

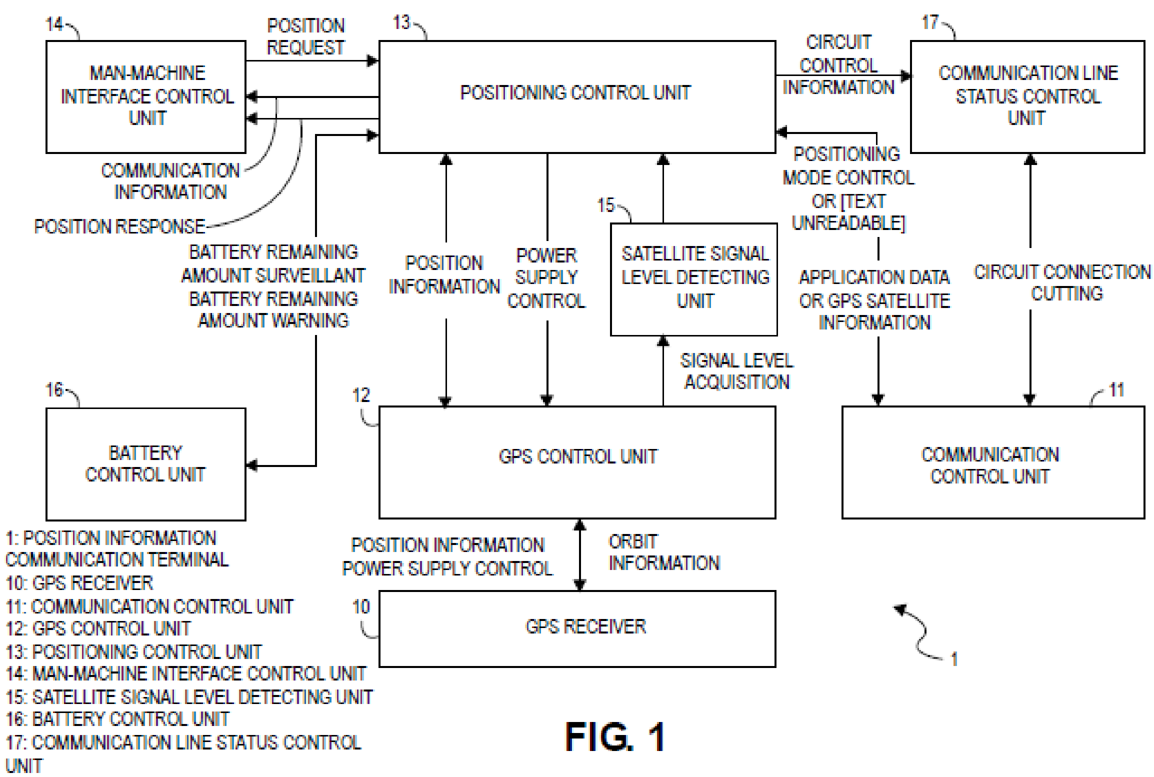

FIG. 1

Figure 1, above, depicts position information communication terminal 1, which includes GPS receiver 10, communication control unit 11 for mobile communications, GPS control unit 12, positioning control unit 13, man-

machine interface control unit 14, satellite signal level detection unit 15, battery control unit 16, and communication line status control unit 17. *Id.* ¶ 19. Battery control unit 16 constantly monitors the remaining battery level. *Id.* ¶ 28. Battery control unit 16 provides positioning control unit 13 a remaining battery life warning when the remaining battery amount falls below a preset threshold value. *Id.* ¶ 19.

Satellite signal level detector 15 detects a level of the GPS signal received by GPS receiver 10 via GPS control unit 12. Ex. 1004 ¶ 19. When the signal level value is equal to or higher than a predetermined threshold value, positioning mode control unit 22 initiates a normal sensitivity positioning mode. *Id.* ¶ 38. Normal sensitivity positioning mode is a mode in which the GPS receiver is operated only when necessary. *Id.* ¶¶ 4–5, 19. When the signal level value is equal to or lower than a predetermined threshold value, positioning mode control unit 22 initiates a high sensitivity positioning mode. *Id.* ¶ 38. High sensitivity positioning mode is a mode in which the GPS receiver is operated constantly. *Id.* ¶¶ 4–5, 19. When the signal level value is equal to or lower than a threshold value associated with the inability to perform positioning, positioning mode control unit 22 stops the position search. *Id.* ¶ 38. A user may select among normal sensitivity positioning mode, high sensitivity positioning mode, and the power-off of terminal 1 via man-machine interface control unit 14. *Id.* ¶¶ 26, 28.

If the GPS satellite signal level detected by satellite signal level detection unit 15 is below threshold value K1, then positioning control unit 13 "automatically makes a transition to the high sensitivity positioning mode." Ex. 1004 ¶ 27. If the GPS satellite signal level detected by satellite signal level detection unit 15 is above a different threshold value K2, then

positioning control unit 13 "automatically makes a transition to the normal sensitivity positioning mode." *Id.*

Figure 2 of Sakamoto is reproduced below.

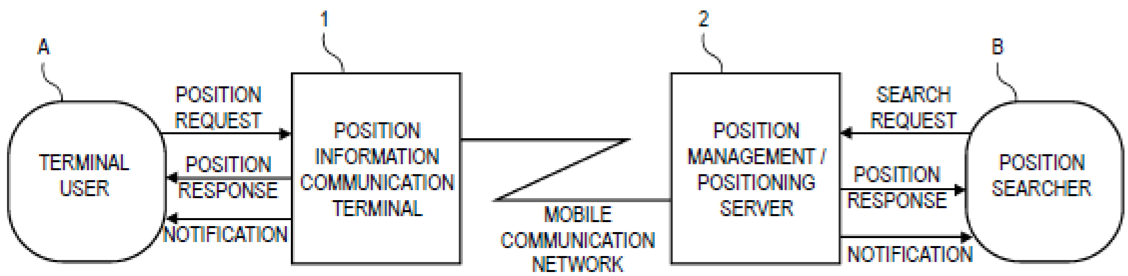

FIG. 2

Figure 2, above, depicts a GPS positioning system with position management/positioning server 2 connected to position information communication terminal 1 by a mobile communication network. Ex. 1004 ¶ 18. Terminal 1 responds to a position request from terminal user A by showing the position of terminal 1 to terminal user A. *Id.* Server 2 responds to a position search request of terminal 1 from position searcher B with a position response. *Id.* Server 2 may also send a position search request message to terminal 1, and terminal 1 responds by sending a search response message including position information to server 2. *See id.* ¶¶ 31–35, Figs. 4, 5.

2. *Claim 8*

a. Petitioner's Contentions

Independent claim 8 recites "[a] local charging management device to manage electrical resource capability for an electronic tracking device that is tracked by at least one other tracking device." Ex. 1001, 16:43–45. For the "local charging management device," Petitioner cites Sakamoto's battery,

battery control unit 16, positioning control unit 13, and GPS control unit 12. Pet. 44. Petitioner maps the "electronic tracking device" to Sakamoto's GPS receiver 10, communication control unit 11, GPS control unit 12, position control unit 13, man-machine interface control unit 14, satellite signal level detecting unit 15, battery control unit 16 and battery, and communication line status controlling unit 17. *Id.* at 13 (citing Ex. 1004 ¶ 19, Fig. 1), 44–45. For "track[ing] by at least one other tracking device," Petitioner contends the "electronic tracking device" is tracked by position management server 2. *Id.* at 44–45; *see also id.* at 15–16 (analyzing similar limitation in claim 1).

Claim 8 further recites "a battery power level monitor." Ex. 1001, 16:46. Petitioner maps this limitation to Sakamoto's battery control unit 16 and GPS control unit 12. Pet. 22–25, 45–46 (citing Ex. 1004, Fig. 1). According to Petitioner, Sakamoto's battery control unit 16 "constantly" monitors a remaining battery amount in order to determine when battery power falls below a predetermined threshold. Pet. 22–24 (citing Ex. 1004 ¶¶ 19, 28, 39).

Claim 8 further recites "a charging unit." Ex. 1001, 16:47. Petitioner cites the battery in Sakamoto's terminal 1 for teaching the recited "charging unit." Pet. 16 (citing Ex. 1004 ¶ 19), 46 (citing Ex. 1004 ¶ 47). In particular, Petitioner relies on the following passage from Sakamoto:

> The position information communication terminal 1 is, as shown in FIG. 1, composed of . . . a battery control unit 16 that notifies the positioning control unit 13 of a remaining battery amount warning when **the remaining amount value of a battery (not shown) that supplies operating power** falls below a preset threshold value.

Id. at 16 (quoting Ex. 1004 ¶ 19) (emphasis by Petitioner).

Claim 8 further recites "an electrical power resource management component to adjust cycle timing of at least one of a request rate of location coordinate packets to a target host and a listen rate of the location coordinate packets responsive to an estimated charge level of the charging unit." Ex. 1001, 16:48–52. According to Petitioner, the '774 patent states that a local battery adjustment mechanism is one example of an "electrical resource management component." Pet. 46 (citing Ex. 1001, 13:13–15). As such, Petitioner cites its analysis from claim 1 in which it maps a local battery power adjustment mechanism to Sakamoto's man-machine interface control unit 14 and positioning control unit 13. Pet. 26–27 (citing Ex. 1004, Fig. 1), 46. Petitioner contends these elements "act in concert to reduce (*i.e.,* 'adjust') the battery usage of *Sakamoto's* terminal." *Id.* at 27 (citing Ex. 1004 ¶ 46).

Petitioner explains that a user sets a "preset threshold value" using man-machine interface control unit 14 "to specify the battery level below which the terminal will automatically switch from high sensitivity positioning mode to normal sensitivity positioning mode." *Id.* at 27–28 (citing Ex. 1004 ¶¶ 29, 46), 47. Based on this threshold value, positioning control unit 13 switches between the high sensitivity positioning mode and the normal sensitivity positioning mode by turning on and off the GPS receiver according to the current positioning mode. *Id.* at 28 (citing Ex. 1003 ¶ 87; Ex. 1004 ¶¶ 20, 24), 47. Petitioner further contends that an ordinarily skilled artisan "would have appreciated that switching the positioning mode updates the communication signaling protocol." *Id.* at 31 (citing Ex. 1003 ¶¶ 89–94), 47 (citing Ex. 1003 ¶¶ 98, 102); *see also id.* at 29–30 (same argument); Pet. Reply 15 (same argument). Petitioner

associates "adjust[ing] cycle timing" of the request rate and/or listen rate with generating such an updated set of communication signaling protocols. Pet. 46–47 (citing Ex. 1003 ¶ 98).

For the recited "listen rate," Petitioner notes that, after an initial position request, "high-sensitivity positioning mode keeps the GPS continuously powered on, 'constantly' updating the position of the terminal," so an ordinarily skilled artisan would have known the GPS receiver to have "an associated refresh rate of location coordinates (commonly 1Hz)." Pet. 31 (citing Ex. 1003 ¶ 90; Ex. 1004 ¶¶ 20, 25, 31, 36), 46–47 (relying on analysis from claim 1). Petitioner further notes that, in Sakamoto's normal sensitivity positioning mode, GPS receiver 10 is powered on and off in response to requests at man-machine interface control unit 14, which Petitioner characterizes as regular or irregular. *Id.* at 32–33 (citing Ex. 1003 ¶ 92; Ex. 1004 ¶¶ 24, 34). Petitioner additionally notes that Sakamoto discloses search requests made during a regular "short cycle." *Id.* at 33 (citing, *inter alia*, Ex. 1004 ¶ 40). Furthermore, Petitioner notes that even when no positioning request is pending, the server may periodically (i.e., at a "cycle set in advance") send a satellite signal level request message, which "causes the terminal to monitor the satellite signal level for a specified length of time and send a 'satellite signal level response message' with signal strength data to the server." *Id.* at 32 (citing Ex. 1004 ¶ 37). As such, Petitioner contends an ordinarily skilled artisan would have understood that the periodic satellite signal request message cycle is "a minimum value for the listen rate of the GPS receiver in normal sensitivity position." *Id.* (citing Ex. 1003 ¶ 92). Finally, Petitioner asserts that the

listen rate for GPS signals is zero when the GPS receiver is in power-off mode. *Id.* at 33–34 (citing Ex. 1003 ¶ 94; Ex. 1004 ¶¶ 28, 39, 51).

For the "request rate," Petitioner contends that search response messages in Sakamoto's normal and high sensitivity modes "are generated in response to a position search request message and as such may be generated in response to a request by a position searcher or repeatedly in a 'short cycle.'" Pet. 33 (citing Ex. 1004 ¶¶ 31–35, 40, 53), 46–47 (relying on analysis from claim 1). In light of this, Petitioner contends that an ordinarily skilled artisan "would have understood that the communication signaling protocol associated with normal sensitivity positioning mode has a response rate that may be irregular (based on manual searches) or regular (at a predefined cycle frequency)." *Id.* at 33 (citing Ex. 1003 ¶¶ 91–92). Petitioner also contends that an ordinarily skilled artisan would have known that the response rate for requests is zero in power-off mode "because GPS signal levels are not monitored and position searching is stopped." *Id.* at 34 (citing Ex. 1003 ¶ 94; Ex. 1004 ¶ 38). Petitioner provides a chart, reproduced below, summarizing its "request rate" and "listen rate" mappings to Sakamoto's teachings.

Communication signaling protocol	**GPS Listen Rate**	**Response Rate (to Request Rate of Location Coordinate Packets)**
High sensitivity positioning mode	Maximum GPS refresh rate (*e.g.*, 1Hz)	irregular request rate or regular "short cycle"
Normal sensitivity positioning mode	irregular request rate, regular "short cycle," or "cycle set in advance"	irregular request rate or regular "short cycle"
Power-off mode	0Hz	0Hz

Id. In this chart from the Petition, Petitioner has listed its contentions regarding the "GPS Listen Rate" and "Response Rate (to Request Rate of Location Coordinate Packets)" for Sakamoto's high and normal sensitivity modes and power-off mode. *Id.*

Claim 8 further recites

> wherein the battery power level monitor measures a power level of the charging unit and adjusts a power level applied to location tracking circuitry responsive to one or more signal levels, the power level comprising a multitude of threshold values determined by a user or system administrator to intermittently activate or deactivate the location tracking circuitry to conserve power of the charging unit in response to the estimated charge level of the charging unit.

Ex. 1001, 16:53–61. Petitioner contends "*Sakamoto* teaches battery control unit 16 measures a power level of the battery." Pet. 48 (citing Ex. 1003 ¶ 101); *see also id.* at 23–24 (citing Ex. 1004 ¶¶ 28, 39). For "adjust[ing] a power level applied to location tracking circuitry," Petitioner cites Sakamoto's teaching of changing the power level applied to GPS receiver 10 depending on positioning mode. *Id.* at 48–49 (citing Ex. 1004 ¶¶ 24, 25). Petitioner contends the adjustment to GPS receiver 10 is "responsive to one or more signal levels" based on Sakamoto's detection of GPS satellite signal levels and teachings of (1) threshold K1, below which positioning control unit 13 automatically transitions to high sensitivity positioning mode; and (2) threshold K2, above which positioning control unit 13 automatically transitions to normal sensitivity positioning mode. *Id.* at 49–50 (citing Ex. 1004 ¶ 27).

For the recited "multitude of threshold values," Petitioner initially cited Sakamoto's teachings of two battery power level thresholds related to (1) the user-defined battery power level threshold below which the mode

switches from high sensitivity positioning mode to normal sensitivity positioning mode; and (2) "a still lower-power mode whereby the GPS receiver is completely shut down." Pet. 50–51 (citing Ex. 1004 ¶¶ 29, 39, 51). Regarding the "still-lower power mode," Petitioner contends an ordinarily skilled artisan "would have understood these teachings of *Sakamoto* to indicate a second battery threshold below which this complete GPS power off occurs." *Id.* at 51 (citing Ex. 1003 ¶ 103).

In its Reply, Petitioner cites two additional thresholds associated with a GPS signal level for teaching the "multitude of threshold values." Pet. Reply 16. According to Petitioner,

> *Sakamoto* teaches that the power level applied to the GPS receiver can be increased (to set the GPS receiver to high sensitivity positioning mode) when the GPS signal level is below a predetermined threshold K1, or decreased (to set the GPS receiver to normal sensitivity mode) when GPS signal level exceeds "a threshold value K2 different from the threshold value K1."

Id. at 16–17 (quoting Ex. 1004 ¶ 27) (citing Ex. 1003 ¶ 58). Petitioner explains that "[t]hese GPS signal level thresholds are used as the basis to 'intermittently activate or deactivate the location tracking circuitry' for the same reasons discussed in the Petition with respect to the battery level thresholds at least because Sakamoto uses the same modes with both sets of thresholds." *Id.* at 17. Petitioner contends that all of its cited thresholds, including K1 and K2, "are used to transition positioning mode and therefore adjust the cycle timing." *Id.*

b. Patent Owner's Arguments

Patent Owner argues that "*Sakamoto* does not disclose more than two thresholds of any one type." PO Sur-reply 13. Patent Owner further argues that it is "improper to combine thresholds unrelated to the power level." *Id.* As such, Patent Owner concludes that "the combination of *Sakamoto's* two power level-related thresholds and two signal-related thresholds to achieve four thresholds, as proposed by Petitioner, is insufficient to disclose this limitation." *Id.* at 14.

c. Analysis

Petitioner cites Sakamoto's two battery power level thresholds (i.e., the battery power thresholds between (1) high and normal sensitivity positioning modes and (2) normal sensitivity positioning mode and turning off power to the GPS receiver) and Sakamoto's two GPS signal level thresholds (i.e., K1 and K2) for teaching "the power level comprising a multitude of threshold values." Pet. 50–51; Pet. Reply 16–18. As discussed above, however, "the power level comprising a multitude of threshold values" refers to battery power level thresholds. *See supra* § II.C.2. We also determine above that signal level threshold values are not within the scope of "the power level comprising a multitude of threshold values." *See id.* Accordingly, we are not persuaded that Sakamoto's GPS signal level thresholds K1 and K2 teach the recited power level threshold values. Although Petitioner is correct that "*Sakamoto* uses the same modes with both sets of thresholds" and that both sets of thresholds might ultimately relate to conserving battery power (*see* Pet. Reply 17 (citing Ex. 1003 ¶ 58; Ex. 1004 ¶¶ 27–29)), we are not persuaded that these different types of

thresholds are interchangeable within the scope of "the power level comprising a multitude of threshold values." This is particularly true given that Petitioner already relies on Sakamoto's GPS signal level thresholds K1 and K2 for teaching another aspect of claim 8, i.e., "responsive to one or more signal levels." *See* Pet. 49–50.

For these reasons, Petitioner has only established that Sakamoto teaches two battery power level thresholds within the scope of "the power level comprising a multitude of threshold values." Because two threshold values are not a "multitude" (*see supra* § II.C.1), we find that Petitioner has not established that Sakamoto teaches "the power level comprising a multitude of threshold values," as recited in claim 8. Thus, we determine Petitioner has not shown by a preponderance of the evidence that the subject matter of claim 8 would have been obvious over Sakamoto.

3. Claims 10, 13, and 15

Claims 10, 13, and 15 each depend from claim 8. Ex. 1001, 17:4–10, 17:23–25, 17:29–33. Petitioner's analysis for these claims does not cure the deficiencies discussed above with respect to claim 8. *See* Pet. 54–55. Thus, we determine Petitioner has not shown by a preponderance of the evidence that the subject matter of claims 10, 13, and 15 would have been obvious over Sakamoto.

E. Obviousness Ground Based on Sakamoto and AAPA

Petitioner contends the subject matter of claims 8, 10, 13, and 15 would have been obvious over the combination of Sakamoto and AAPA. Pet. 60. Petitioner's further analysis based on AAPA does not cure the

deficiencies discussed above with respect to claims 8, 10, 13, and 15 in the Sakamoto obviousness ground. *See supra* §§ II.D.2–3. Thus, we determine Petitioner has not shown by a preponderance of the evidence that the subject matter of claims 8, 10, 13, and 15 would have been obvious over the combination of Sakamoto and AAPA.

F. Obviousness Ground Based on Sakamoto and Hayasaka

Petitioner contends the subject matter of claims 8, 10, 13, and 15 would have been obvious over the combination of Sakamoto and Hayasaka. Pet. 70–71. Petitioner's further analysis based on Hayasaka does not cure the deficiencies discussed above with respect to claims 8, 10, 13, and 15 in the Sakamoto obviousness ground. *See supra* §§ II.D.2–3. Thus, we determine Petitioner has not shown by a preponderance of the evidence that the subject matter of claims 8, 10, 13, and 15 would have been obvious over the combination of Sakamoto and Hayasaka.

III. CONCLUSION

Petitioner has not shown, by a preponderance of the evidence, that (1) the subject matter of claims 8, 10, 13, and 15 would have been obvious over Sakamoto; (2) the subject matter of claims 8, 10, 13, and 15 would have been obvious over the combination of Sakamoto and AAPA; or (3) the subject matter of claims 8, 10, 13, and 15 would have been obvious over the combination of Sakamoto and Hayasaka.

In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
8, 10, 13, 15	103(a)	Sakamoto		8, 10, 13, 15
8, 10, 13, 15	103(a)	Sakamoto, AAPA		8, 10, 13, 15
8, 10, 13, 15	103(a)	Sakamoto, Hayasaka		8, 10, 13, 15
Overall Outcome				8, 10, 13, 15

IV. ORDER

Accordingly, it is

ORDERED that claims 8, 10, 13, and 15 of the ’774 patent are not unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

PETITIONER:

Jennifer C. Bailey
Adam P. Seitz
Robin Snader
ERISE IP, P.A.
jennifer.bailey@eriseip.com
adam.seitz@eriseip.com
robin.snader@eriseip.com

PATENT OWNER:

Shaun D. Gregory
TAFT STETTINIUS & HOLLISTER LLP
sgregory@taftlaw.com

US008497774B2

(12) **United States Patent**
Scalisi et al.

(10) **Patent No.: US 8,497,774 B2**
(45) **Date of Patent: Jul. 30, 2013**

(54) **APPARATUS AND METHOD FOR ADJUSTING REFRESH RATE OF LOCATION COORDINATES OF A TRACKING DEVICE**

(75) Inventors: **Joseph F. Scalisi**, Yorba Linda, CA (US); **Roger B. Anderson**, Arcadia, CA (US)

(73) Assignee: **Location Based Technologies Inc.**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 992 days.

(21) Appl. No.: **12/419,451**

(22) Filed: **Apr. 7, 2009**

(65) **Prior Publication Data**

US 2009/0189807 A1 Jul. 30, 2009

Related U.S. Application Data

(63) Continuation-in-part of application No. 11/969,905, filed on Jan. 6, 2008, now Pat. No. 8,102,256, and a continuation-in-part of application No. 11/753,979, filed on May 25, 2007, and a continuation-in-part of application No. 11/933,024, filed on Oct. 31, 2007, and a continuation-in-part of application No. 11/784,400, filed on Apr. 5, 2007, now abandoned, and a continuation-in-part of application No. 11/935,901, filed on Nov. 6, 2007, now Pat. No. 8,244,468, and a continuation-in-part of application No. 11/784,318, filed on Apr. 5, 2007, now abandoned.

(51) **Int. Cl.**
G08B 1/08 (2006.01)

(52) **U.S. Cl.**
USPC **340/539.13**

(58) **Field of Classification Search**
USPC 340/539.13, 539.21, 686.1, 636.1, 340/636.2, 636.19; 320/108
See application file for complete search history.

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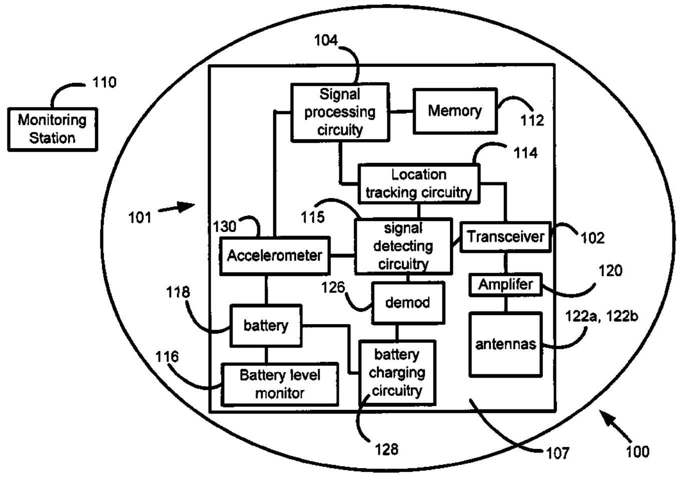
Primary Examiner — Phung Nguyen
(74) *Attorney, Agent, or Firm* — Timberline Patent Law Group PLLC; Mark Farrell

(57) **ABSTRACT**

A local charging management device manages electrical resource capability for an electronic tracking device. In one embodiment, the electronic tracking device includes a battery power monitor, a charging unit; and an electrical power resource management component. The electrical power resource management component adjusts cycle timing of one or more of control parameters for the tracking device. Control parameters include request rate of location coordinate packets to a target host and a listen rate of the location coordinate packets. The adjustment is responsive to an estimated charge level of the charging unit, velocity of the device, and user desired inputs.

19 Claims, 7 Drawing Sheets



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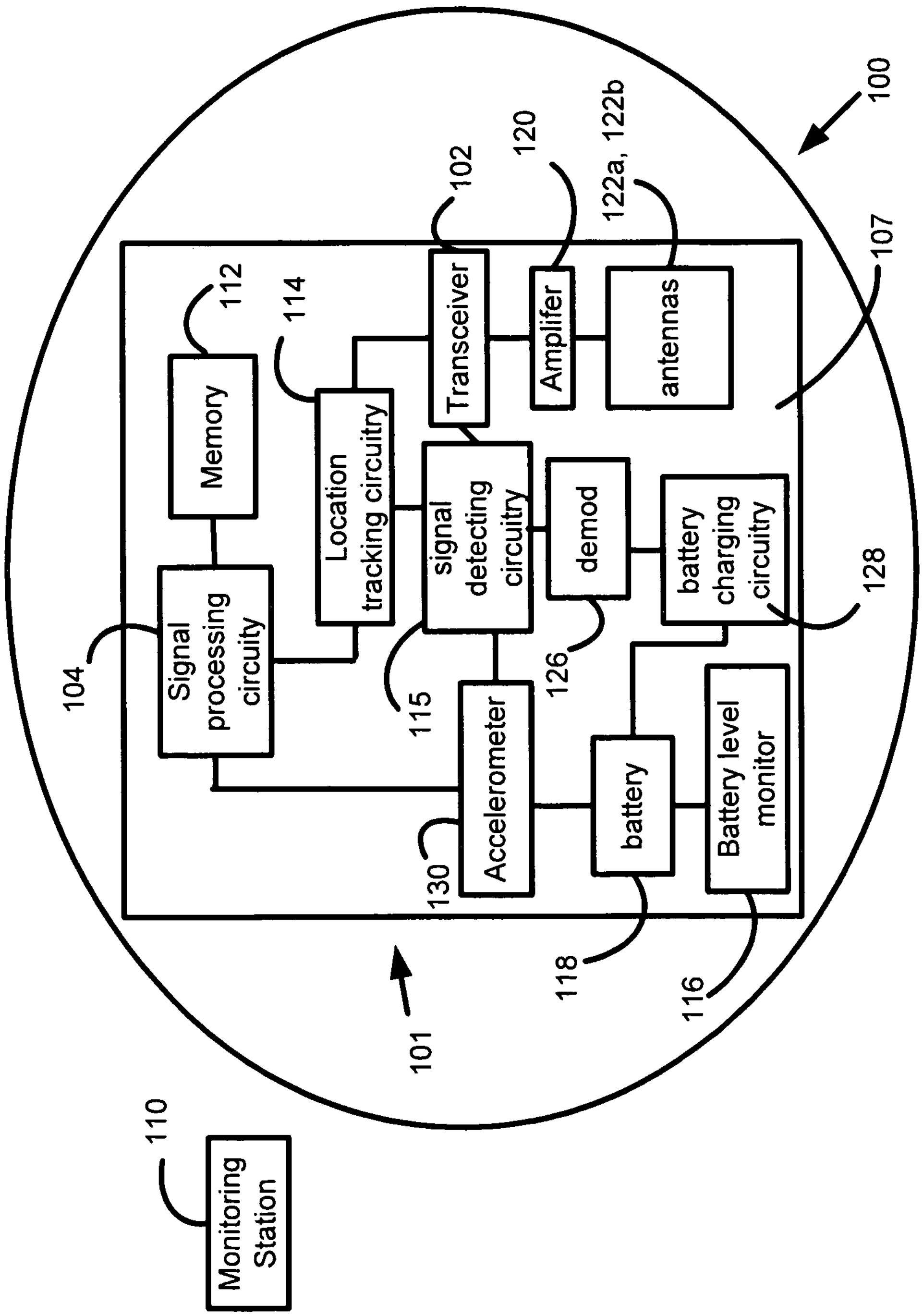
100
101
102
104
107
110
112
114
115
116
118
120
122a, 122b
126
128
130
Memory
Location tracking circuitry
Transceiver
Amplifer
antennas
Signal processing circuity
signal detecting circuitry
demod
battery charging circuitry
Accelerometer
battery
Battery level monitor
Monitoring Station

Figure 1

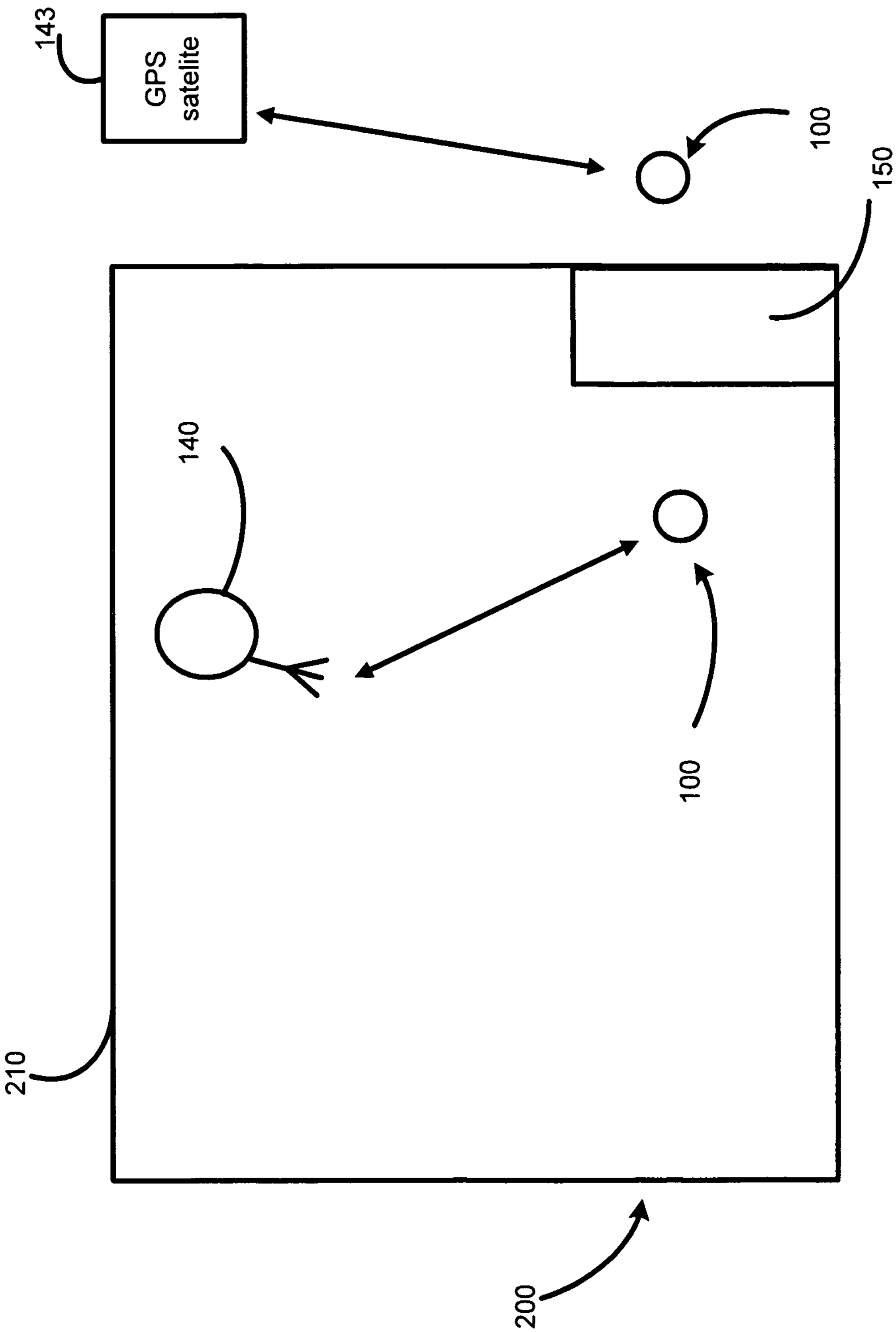

Figure 2

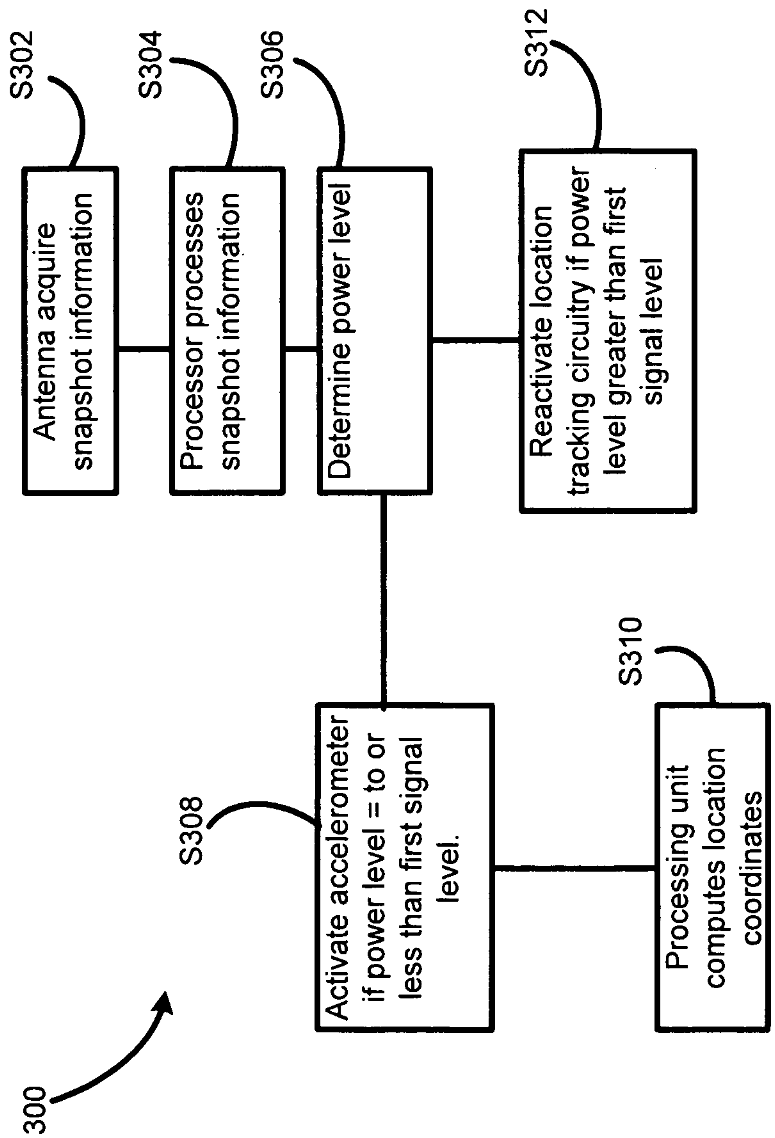
300
S302
Antenna acquire snapshot information
S304
Processor processes snapshot information
S306
Determine power level
S312
Reactivate location tracking circuitry if power level greater than first signal level
S308
Activate accelerometer if power level = to or less than first signal level.
S310
Processing unit computes location coordinates

Figure 3

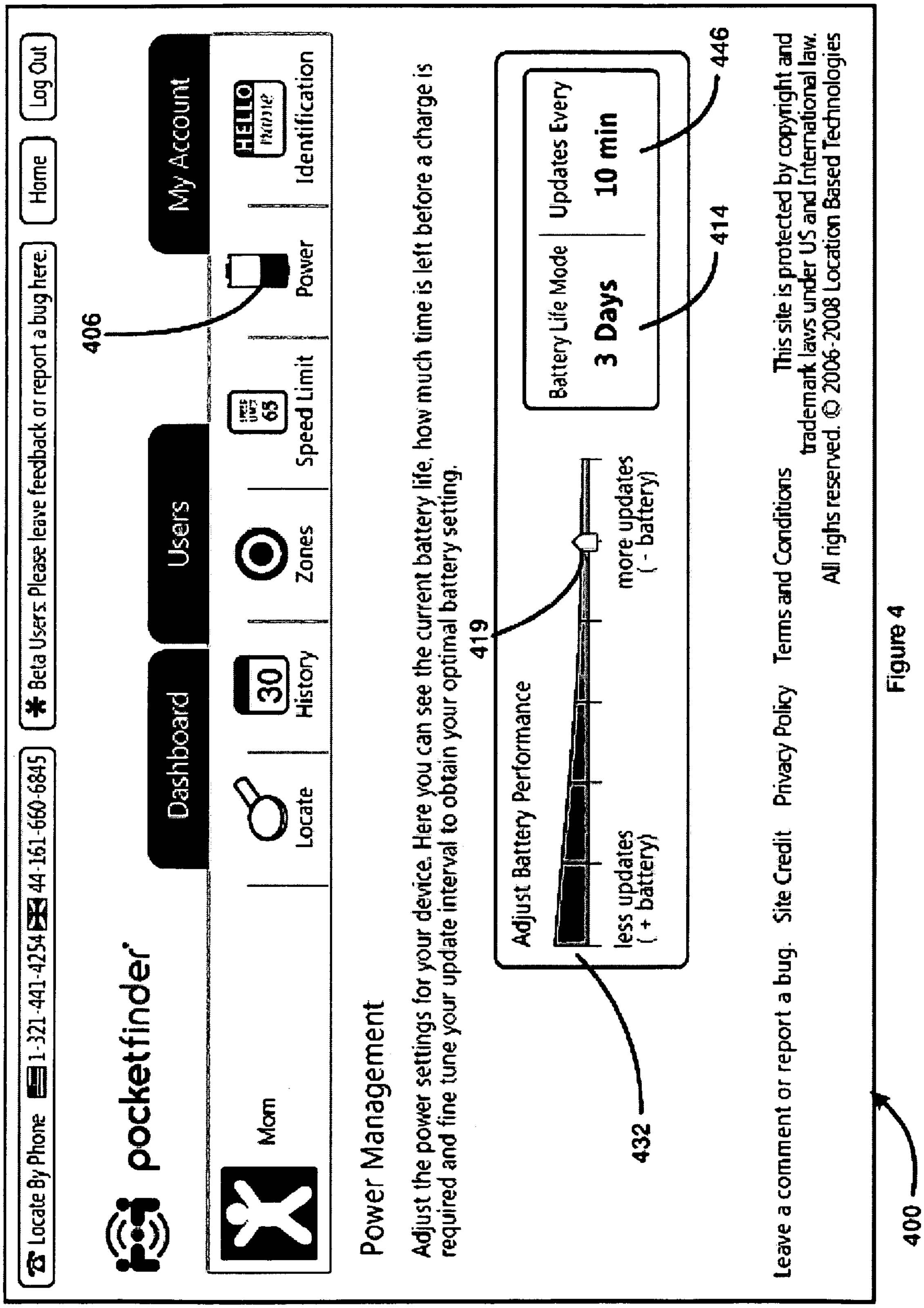
Locate By Phone 1-321-441-4254 44-161-660-6845
Beta Users: Please leave feedback or report a bug here.
Home
Log Out
pocketfinder
Dashboard
Users
My Account
Mom
Locate
History
Zones
Speed Limit
Power
Identification
HELLO name
Power Management
Adjust the power settings for your device. Here you can see the current battery life, how much time is left before a charge is required and fine tune your update interval to obtain your optimal battery setting.
Adjust Battery Performance
less updates (+ battery)
more updates (- battery)
Battery Life Mode
3 Days
Updates Every
10 min
406
419
432
414
446
400
Leave a comment or report a bug. Site Credit Privacy Policy Terms and Conditions
This site is protected by copyright and trademark laws under US and International law.
All righs reserved. © 2006-2008 Location Based Technologies

Figure 4

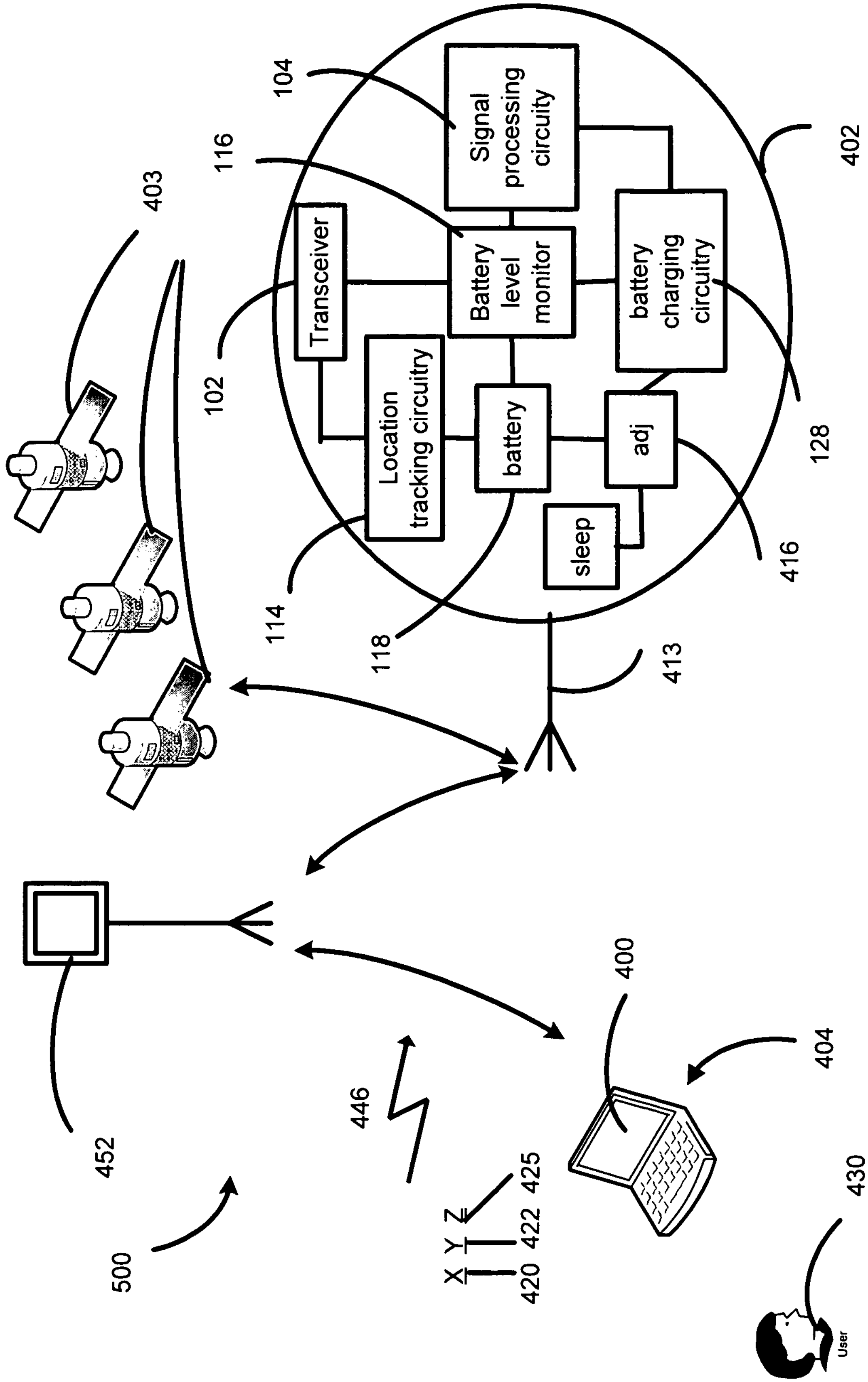
Signal processing circuity
Transceiver
Battery level monitor
battery charging circuitry
Location tracking circuitry
battery
adj
sleep
User
104
116
403
402
102
128
114
118
416
413
400
404
446
452
425
422
420
X
Y
Z
430
500

Figure 5

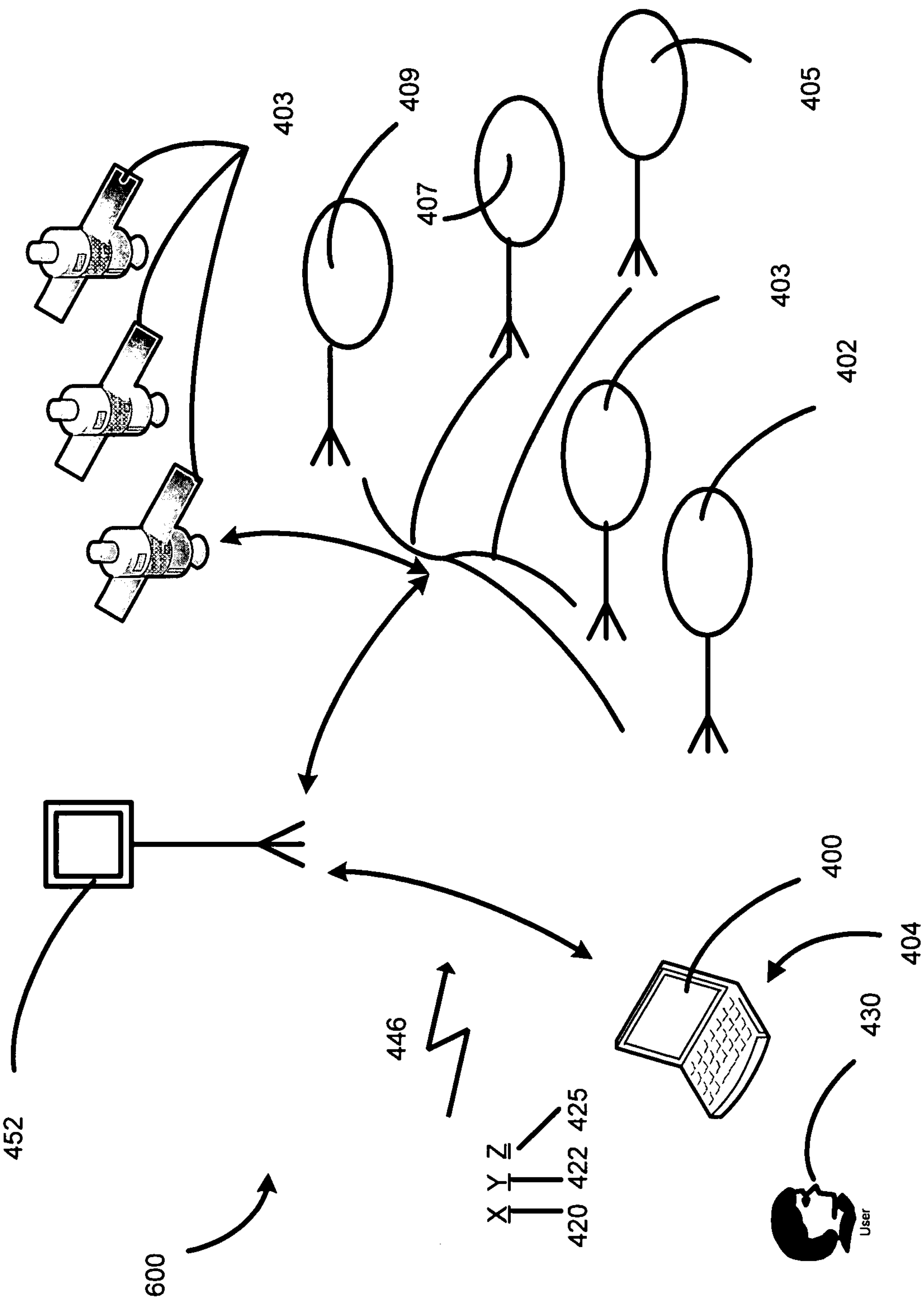
403
409
405
407
403
402
400
404
430
446
452
600
X
Y
Z
420
422
425
User

Figure 6

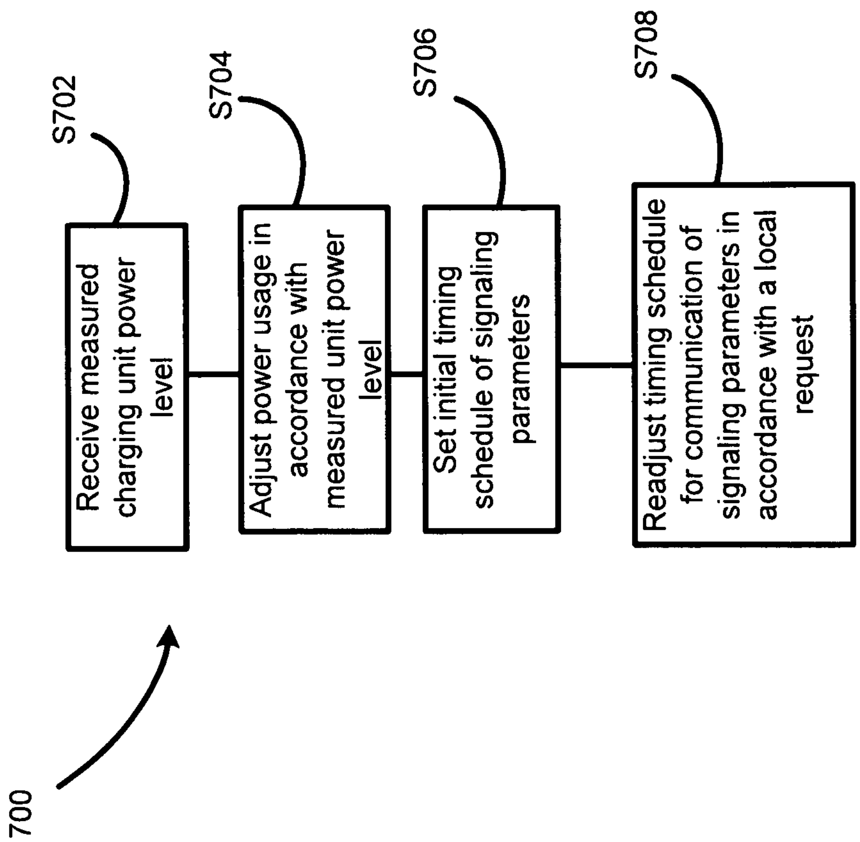
700
S702
Receive measured charging unit power level
S704
Adjust power usage in accordance with measured unit power level
S706
Set initial timing schedule of signaling parameters
S708
Readjust timing schedule for communication of signaling parameters in accordance with a local request

Figure 7

APPARATUS AND METHOD FOR ADJUSTING REFRESH RATE OF LOCATION COORDINATES OF A TRACKING DEVICE

PRIORITY AND RELATED APPLICATIONS

This application is a continuation-in-part of and claims priority to U.S. Pat. No. 8,102,256, originally filed as U.S. patent application Ser. No. 11/969,905 entitled "Apparatus and Method for Determining Location and Tracking Coordinates of a Tracking Device" that was filed on Jan. 6, 2008; and incorporates by reference in their entirety and claims priority to: U.S. patent application Ser. No. 11/753,979 filed on May 25, 2007, entitled "Apparatus and Method for Providing Location Information on Individuals and Objects Using Tracking Devices"; U.S. patent application Ser. No. 11/933,024 filed on Oct. 31, 2007, entitled "Apparatus and Method for Manufacturing an Electronic Package"; U.S. patent application Ser. No. 11/784,400 filed on Apr. 5, 2007, entitled "Communication System and Method Including Dual Mode Capability"; U.S. patent application Ser. No. 11/784,318 filed on Apr. 5, 2007, entitled "Communication System and Method Including Communication Billing Options"; and U.S. Pat. No. 8,244,468, originally filed as U.S. patent application Ser. No. 11/935,901 filed on Nov. 6, 2007, entitled "System and Method for Creating and Managing a Personalized Web Interface for Monitoring Location Information on Individuals and Objects Using Tracking Devices."

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates generally to the field of location and tracking communication systems. More particularly, the present invention relates in one embodiment to a power conservation methodology and apparatus incorporated as part of portable electronic tracking device for individuals and objects to improve battery life by a wireless location and tracking system and/or wireless communication system (WCS).

2. Description of Related Technology

Accelerometers are conventionally integrated into electronics systems that are part of a vehicle, vessel, and airplane to detect, measure, and monitor deflections, vibrations, and acceleration. Accelerometers, for example, may include one or more Micro Electro-Mechanical System (MEMS) devices. In particular, MEMS devices include one or more suspended cantilever beams (e.g., single-axis, dual-axis, and three-axis models), as well as deflection sensing circuitry. Accelerometers are utilized by a multitude of electronics manufacturers.

For instance, electronics gaming manufacturers exploit an accelerometer's deflection sensing capability, for instance, to measure device tilt and control game functionality. In another instance, consumer electronics manufacturers, e.g., Apple, Ericsson, and Nike, incorporate accelerometers in personal electronic devices, e.g., Apple iPhone to provide a changeable screen display orientation that toggles between portrait and landscape layout window settings; to manage human inputs through a human interface, e.g., Apple iPod® touch screen interface; and to measure game movement and tilt, e.g., Wii gaming remotes. Still others including automobile electronics circuitry manufacturers utilize MEMS accelerometers to initiate airbag deployment in accordance with a detected collision severity level by measuring negative vehicle acceleration.

Other electronics manufacturer products, e.g., Nokia 5500 sport, count step motions using a 3D accelerometer, and translate user information via user's taps or shaking motion to

select song titles and to enable mp3 player track switching. In another instance, portable or laptop computers include hard-disk drives integrated with an accelerometer to detect displacement or falling incidents. For instance, when a hard-disk accelerometer detects a low-g condition, e.g., indicating free-fall and expected shock, a hard-disk write feature may be temporarily disabled to avoid accidental data overwriting and prevent stored data corruption. After free-fall and expected shock, the hard-disk write feature is enabled to allow data to be written to one or more hard-disk tracks. Still others including medical product manufacturers utilize accelerometers to measure depth of Cardio Pulmonary Resuscitation (CPR) chest compressions. Sportswear manufacturers, e.g., Nike sports watches and footwear, incorporate accelerometers to feedback speed and distance to a runner via a connected iPod® Nano.

Still others including manufacturers of conventional inertial navigation systems deploy one or more accelerometers as part of, for instance, on-board electronics of a vehicle, vessel, train and/or airplane. In addition to accelerometer measurements, conventional inertial navigation systems integrate one or more gyroscopes with the on-board electronics to assist tracking including performing various measurements, e.g., tilt, angle, and roll. More specifically, gyroscopes measure angular velocity, for instance, of a vehicle, vessel, train, and/or airplane in an inertial reference frame. The inertial reference frame, provided, for instance, by a human operator, a GPS receiver, or position and velocity measurements from one or more motion sensors.

More specifically, integration of measured inertial accelerations commences with, for instance, original velocity, for instance, of a vehicle, vessel, train, and/or airplane to yield updated inertial system velocities. Another integration of updated inertial system velocities yields an updated inertial system orientation, e.g., tilt, angle, and roll, within a system limited positioning accuracy. In one instance to improve positioning accuracy, conventional inertial navigation systems utilize GPS system outputs. In another instance to improve positioning accuracy, conventional inertial navigation systems intermittently reset to zero inertial tracking velocity, for instance, by stopping the inertial navigation system. In yet other examples, control theory and Kalman filtering provide a framework to combine motion sensor information in attempts to improve positional accuracy of the updated inertial system orientation.

Potential drawbacks of many conventional inertial navigation systems include electrical and mechanical hardware occupying a large real estate footprint and requiring complex electronic measurement and control circuitry with limited applicably to changed environmental conditions. Furthermore, many conventional inertial navigation system calculations are prone to accumulated acceleration and velocity measurement errors. For instance, many conventional inertial navigation acceleration and velocity measurement errors are on the order of 0.6 nautical miles per hour in position and tenths of a degree per hour in orientation.

In contrast to conventional inertial navigation systems, a conventional Global Positioning Satellite (GPS) system uses Global Positioning Signals (GPS) to monitor and track location coordinates communicated between location coordinates monitoring satellites and an individual or an object having a GPS transceiver. In this system, GPS monitoring of location coordinates is practical when a GPS transceiver receives at least a minimal GPS signal level. However, a minimal GPS signal level may not be detectable when an individual or object is not located in a skyward position. For instance, when an individual or object carrying a GPS transceiver enters a

covered structure, e.g., a garage, a parking structure, or a large building, GPS satellite communication signals may be obstructed or partially blocked, hindering tracking and monitoring capability. Not only is a GPS transceiver receiving a weak GPS signal, but also the GPS transceiver is depleting battery power in failed attempts to acquire communication signals from one or more location coordinates monitoring satellites, e.g., GPS satellites, or out-of-range location coordinates reference towers. Furthermore, weak GPS communication signals may introduce errors in location coordinates information.

In addition during the acquisition of signaling and or other information, a conventional GPS transceiver has limited functionality or capabilities associated with control and monitoring of battery power usage. For instance, a conventional GPS transceiver may have some indication battery charge level such as a power level bar but have very few or any ability or capability to control or reduce power usage. Furthermore, often users do not realize or are only alerted when their GPS transceiver is using reserve power or about to suddenly involuntarily shut-down to prevent data loss and loss of other user information such as personal GPS settings, screen color displays, and user recreational or pleasure settings.

More specifically, users of conventional GPS transceivers typically are unprepared for such a sudden loss of GPS transceiver service. Generally, within minutes of an initial warning indication, e.g., beeping, vibration, voice, alarms or combination thereof, the GPS transceiver shuts off. As such, a user may suddenly experience loss of location determination or location based capabilities or monitoring or being monitored capabilities and not prepared for such sudden outage. Furthermore, even if a user could reduce battery power usage, a result, within the last few minutes of battery power, a user has little or no incentive or capability to alter battery usage of a conventional GPS transceiver due to low power level GPS transceivers may suddenly become non-operational without any warning to or recourse to a user. Thus, when a conventional GPS transceiver is low in power level, a user's most viable alternative would be locating an electrical outlet to recharge their conventional GPS transceiver.

In summary, electronic tracking device and methodology that provides additional advantages over conventional systems such as improved power management, e.g., efficient use of battery power and provide other improvements include supplementing conventional electronic tracking device monitoring, e.g., increased measurement accuracy of location coordinates of objects and individuals traveling into and/or through a structure, e.g., a partially covered building, a parking structure, or a substantially enclosed structure, such as a basement or a storage area in a high-rise office building.

SUMMARY OF THE INVENTION

In a first aspect of the present invention, a portable electronic apparatus for a tracking device is disclosed. In one embodiment, the tracking device includes a battery having a battery charge level, transceiver circuitry, processor circuitry, and a battery power monitor. In one embodiment, the battery power monitor measures in real-time the battery charge level and makes a prediction of an estimated remaining battery charge level in response to the battery charge level.

In one variant, a local battery power adjustment mechanism generates in substantially real-time an updated set of network communication signaling protocols associated with at least one of a request rate of location coordinate packets to be communicated to a target host and a listen rate of the location coordinate packets. In yet another variant, the updated set of network communication signaling protocols has a value that is responsive to a user input request. In yet another embodiment, the local battery power adjustment mechanism activates or deactivates one or more portions of the transceiver circuitry to conserve the battery charge level. In yet another embodiment, the local battery power adjustment mechanism activates or deactivates the processor to conserve the battery charge level in response to the value having the value responsive to a user input request.

In a second aspect of the present invention, a local charging management device is disclosed to manage electrical resource capability for an electronic tracking device that is tracked by at least one other tracking device. In one embodiment, local charging management device includes a battery power monitor, a charging unit; and an electrical power resource management component. In one variant, the power resource management component adjusts cycle timing of a request rate of location coordinate packets communicated to a target host responsive to an estimate charge level of the charging unit. In another variant, the power resource management component adjusts a listen rate of location coordinate packets responsive to an estimated charge level of the charging unit. In yet another variant, the power resource management component adjusts one or more of request rate of location coordinate packets to a target host and a listen rate of location coordinate packets responsive to an estimated charge level of the charging unit.

In another aspect of the present invention, a method is disclosed to control power usage. In one embodiment, the method includes measurement of charging unit power level of a tracking device communicated by a location coordinate tracking system, and adjustment of charging unit power level of the tracking device in response to a substantially-real life estimate of the unit power level of a charge unit of the tracking device. In one variant, the method includes creation of an initial timing schedule for communication of signaling parameters associated with a request rate communicated with location coordinate information and listen rate communicated with the location coordinate information, the initial time schedule being at least partially automatically and responsive to an estimated power level of the charge unit. In yet another variant, the method includes readjustment of the initial timing schedule for communication of signaling parameters in accordance with a local request by a remote user using an Internet accessible icon that displays user viewable tradeoffs between the estimated charge unit life and charge unit update rate.

These and other embodiments, aspects, advantages, and features of the present invention will be set forth in part in the description which follows, and in part will become apparent to those skilled in the art by reference to the following description of the invention and referenced drawings or by practice of the invention. The aspects, advantages and features of the invention are realized and attained by means of the instrumentalities, procedures, and combinations particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a schematic of an electronic tracking device in accordance with an embodiment of the present invention.

FIG. **2** illustrates a location tracking system associated with the electronic tracking device and the wireless network in accordance with an embodiment of the present invention.

FIG. **3** illustrates a flow diagram to manage and control circuitry associated with the electronic tracking device of FIGS. **1** and **2** in accordance with an embodiment of the present invention.

FIG. **4** illustrates a screen display including a user definable adjustable power level monitor in accordance with an embodiment of the present invention.

FIG. **5** illustrates a location coordinate navigational system utilizing user definable power level monitor of FIG. **4** in accordance with an embodiment of the present invention.

FIG. **6** illustrates a location coordinate navigation system utilizing a user definable power level monitor of FIG. **4** in accordance with an embodiment of the present invention.

FIG. **7** illustrates a flow diagram of a user definable adjustable power level monitor in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION

Reference is now made to the drawings wherein like numerals refer to like parts throughout.

As used herein, the terms "location coordinates" refer without limitation to any set or partial set of integer, real and/or complex location data or information such as longitudinal, latitudinal, and elevational positional coordinates.

As used herein, the terms "tracking device" and "electronic tracking device" refers to without limitation to any hybrid electronic circuit, integrated circuit (IC), chip, chip set, system-on-a-chip, microwave integrated circuit (MIC), Monolithic Microwave Integrated Circuit (MMIC), low noise amplifier, power amplifier, transceiver, receiver, transmitter and Application Specific Integrated Circuit (ASIC) that may be constructed and/or fabricated. The chip or IC may be constructed ("fabricated") on a small rectangle (a "die") cut from, for example, a Silicon (or special applications, Sapphire), Gallium Arsenide, or Indium Phosphide wafer. The IC may be classified, for example, into analogue, digital, or hybrid (both analogue and digital on the same chip and/or analog-to-digital converter). Digital integrated circuits may contain anything from one to millions of logic gates, invertors, and, or, nand, and nor gates, flipflops, multiplexors, etc. on a few square millimeters. The small size of these circuits allows high speed, low power dissipation, and reduced manufacturing cost compared with board-level integration.

As used herein, the terms "data transfer", "tracking and location system", "location and tracking system", "location tracking system", and "positioning system," refer to without limitation to any system that transfers and/or determines location coordinates using one or more devices, such as Global Positioning System (GPS).

As used herein, the terms "Global Positioning System" refer to without limitation to any services, methods or devices that utilize GPS technology to determine position of a GPS receiver based on measuring a signal transfer time of signals communicated between satellites having known positions and the GPS receiver. A signal transfer time is proportional to a distance of a respective satellite from the GPS receiver. The distance between a satellite and a GPS receiver may be converted, utilizing signal propagation velocity, into a respective signal transfer time. The positional information of the GPS receiver is calculated based on distance calculations from at least four satellites to determine positional information of the GPS receiver.

As used herein, the terms "wireless network", "wireless communication", "wireless link", and "wireless transmission" refers to, without limitation, any digital, analog, microwave, and millimeter wave communication networks that transfer signals from one location to another location, such as, but not limited to IEEE 802.11 g, Bluetooth, WiMax, IS-95, GSM, IS-95, CGM, CDMA, wCDMA, PDC, UMTS, TDMA, and FDMA, or combinations thereof.

Major Features

In one aspect, the present invention discloses an apparatus and method to provide an improved capability electronic tracking device. In one embodiment, the device provides electronic circuitry including an accelerometer to measure location coordinates without requiring GPS signaling. In this embodiment, location coordinates of an electronic tracking device are measured when the electronic tracking device is located in a partially enclosed structure, e.g., a building or parking lot, up to a fully enclosed structure. In one embodiment, the electronic tracking device conserves battery power when the device is partially or fully blocked access to location coordinates from one or more GPS satellites, e.g., a primary location tracking system. In yet another embodiment, accelerometer measures force applied to the electronic tracking device and provides an alert message to a guardian or other responsible person. In one embodiment, the alert message includes location coordinates of the electronic tracking device and other information, e.g., magnitude or nature of force, as well as possibility of injury of an object or individual having the electronic tracking device. As described though out the following specification, the present invention generally provides a portable electronic device configuration for locating and tracking an individual or an object.

Exemplary Apparatus

Referring now to FIGS. **1**-**2** and **4**-**6** exemplary embodiments of the electronic tracking device of the invention are described in detail. Please note that the following discussions of electronics and components for an electronic tracking device to monitor and locate individuals are non-limiting; thus, the present invention may be useful in other electronic signal transferring and communication applications, such as electronics modules included in items such as: watches, calculators, clocks, computer keyboards, computer mice, and/or mobile phones to location and track trajectory of movement and current location of these items within boundaries of or proximity to a room, building, city, state, and country.

Furthermore, it will be appreciated that while described primarily in the context of tracking individuals or objects, at least portions of the apparatus and methods described herein may be used in other applications, such as, utilized, without limitation, for control systems that monitor components such as transducers, sensors, and electrical and/or optical components that are part of an assembly line process. Moreover, it will be recognized that the present invention may find utility beyond purely tracking and monitoring concerns. Myriad of other functions will be recognized by those of ordinary skill in the art given the present disclosure.

Electronic Tracking Device

Referring to FIG. **1**, tracking device **100** contains various electronic components **101** such as transceiver **102**, signal processing circuitry **104** (e.g., a microprocessor or other signal logic circuitry), and accelerometer **130**. In one non-limiting example, the electronic components **101** are disposed, deposited, or mounted on a substrate **107** (e.g., Printed Circuit Board (PCB)). The PCB **107**, for example, may be manufactured from: polyacrylic (PA), polycarbonate (PC), composite material, and arylonitrile-butadiene-styrene (ABS) substrates, blends or combinations thereof, or the like (as described in more detail in incorporated by reference U.S. patent application Ser. No. 11/933,024 filed on Oct. 31, 2007). The signal processing circuitry **104**, in one example, associated with the tracking device **100** configured to store a

first identification code, produce a second identification code, determine location coordinates, and generate a positioning signal that contains location data (as described in more detail in incorporated by reference U.S. patent application Ser. No. 11/753,979 filed on May 25, 2007). For instance, the location data includes longitudinal, latitudinal, and elevational position of a tracking device, current address or recent address of the tracking device, a nearby landmark to the tracking device, and the like. In one example, electronic tracking device **100** is portable, mobile and fits easily within a compact volume, such as standard shirt pocket having approximate dimensions of 1.5 inch by 2.5 inch by 1.0 inch. In yet another example, electronic tracking device **100** may be one integrated circuit having dimensionality in the mm range in all directions (or even smaller).

In one embodiment, location tracking circuitry **114**, calculates location data received and sends the data to signal processing circuitry **104**. Memory **112** stores operating software and data, for instance, communicated to and from signal processing circuit **104** and/or location tracking circuitry **114**, e.g., GPS logic circuitry. In one embodiment, a signal detecting circuitry **115** detects and measures signal power level. In another embodiment, the signal processing circuitry **104** processes and measures signal power level. Battery level detection circuitry (e.g., battery level monitor **116**) detects a battery level of battery **118**, which contains one or more individual units or grouped as a single unit.

In one non-limiting example, antennas **122***a*, **122***b* electrically couple to transceiver **102**. In one variant, transceiver **102** includes one integrated circuit or, in another embodiment, may be multiple individual circuits or integrated circuits. Transceiver **102** communicates a signal including location data between tracking device **100** and the monitoring station **110**, for example, by any of the following including: wireless network, wireless data transfer station, wired telephone, and Internet channel. A demodulator circuit **126** extracts baseband signals, for instance at 100 KHz, including tracking device configuration and software updates, as well as converts a low-frequency AC signal to a DC voltage level. The DC voltage level, in one example, is supplied to battery charging circuitry **128** to recharge a battery level of the battery **118**. In one embodiment, a user of monitoring station **110**, e.g., a mobile personal digital assistant, mobile phone, or the like, by listening (or downloading) one or more advertisements to reduce and/or shift usage charges to another user, account, or database (as described in more detail in previous incorporated by reference U.S. patent application Ser. No. 11/784,400 and Ser. No. 11/784,318 each filed on Apr. 5, 2007).

In another embodiment, an accelerometer **130**, for example, a dual-axis accelerometer **130**, e.g. ADXL320 integrated circuit manufactured by Analog Devices having two substantially orthogonal beams, may be utilized. The data sheet ADXH320L from Analog Devices is incorporated by reference. In one embodiment, the accelerometer **130** activates upon one or more designated antenna(s), e.g., antennas **122***a*, **122***b*, detecting a first signal level, e.g., a low signal level or threshold value, as specified by, for instance, a user or system administrator. In one variant of this embodiment, electrical circuitry associated with GPS signal acquisition, e.g., all or a portion of amplifier block **120**, may be, for instance, placed on standby or in a sleep mode. In another embodiment, the accelerometer **130** remains in a standby mode until, for instance, a system administrator, a specified time period, or a user activates the accelerometer **130**. In one embodiment, the amplifier block **120** includes multiple electronic functions and blocks including a low noise amplifier, a power amplifier, a RF power switch, or the like, placed in a sleep or standby mode, for instance, to converse a battery level of the battery **118**.

In another variant of this embodiment, circuitry, such as amplifier block **120** or location tracking circuitry **114**, may be placed in a sleep or standby mode to conserve a battery level of the battery **118**. In one variant, the tracking device **100** periodically checks availability of GPS signal, e.g., performs a GPS signal acquisition to determine if a receive communication signal is above a first signal level. Referring to embodiment depicted in FIG. **2**, electronic tracking device **100** exits an opening **150** in partially enclosed structure **210**; thus, electronic tracking device **100** may resume GPS signal acquisition using GPS satellite **143** (e.g., in response to a periodic check by the tracking device **100** of a receive communication signal level above a first signal level).

In one embodiment, system administrator selects a signal noise bandwidth, e.g., within a range of 3 to 500 Hz, of the accelerator **130** to measure dynamic acceleration (e.g., due to vibration forces applied to electronic tracking device **100**). In another embodiment, system administrator selects a signal noise bandwidth, e.g., within a range of 3 to 500 Hz, to measure static acceleration (due to gravitational forces applied to electronic tracking device **100**). In particular, external forces on electronic tracking device **100** cause, for example, internal structural movements, e.g., deflection of dual-axis beams, of the accelerometer **130**. The deflection of dual-axis beams generates differential voltage(s).

Differential voltage(s) are proportional to acceleration measurements, e.g., discrete acceleration measurements, of electronic tracking device **100**, for instance in x, y, and z directions. Differential voltage(s), in one instance, are relative to, for instance, a last known GPS location coordinates of electronic tracking device **100**. By performing electronic device proximity measurements, e.g., measuring acceleration vectors of electronic tracking device **100** at time intervals, e.g., T1, T2, T3 . . . TN, monitoring station **110** computes electronic tracking device velocity at time intervals, e.g., T1, T2, T3 . . . TN. In one embodiment, time intervals, e.g., T1, T2, and T3 . . . TN are measured in accordance with instructions by a system administrator or user. In one embodiment, time intervals are selected within a range of one micro-second to several minutes.

In one embodiment, the monitoring station **110** performs an integration of the acceleration measurements as a function of time to compute electronic tracking device velocity at time intervals, e.g., T1, T2, and T3 . . . TN. By referencing prior location coordinates, e.g., last known accurate location data of the electronic tracking device **100** or last known location data of nearby electronic tracking device (e.g., second tracking device **101** in proximity to electronic tracking device **100**), monitoring station **110** computes a current location of electronic tracking device **100** utilizing electronic tracking device velocity computations. Advantageously, monitoring station **110**, in an above described embodiment, uses above described device proximity measurements to monitor current location data of electronic tracking device **100** without connectivity to receive communication signals from GPS satellites.

In one embodiment, the monitoring station **110** may include a mobile phone having connectivity to wireless network **140** electrically coupled to electronic tracking device **100** (FIG. **2**). In this variant, the wireless network **140** resides or circulates within at least a portion of a semi-enclosed, partially-enclosed, or fully enclosed structure, e.g., building, parking structure, closet, storage room, or the like (e.g., structure **210** in FIG. **2**). Furthermore, in one embodiment, the

present invention conserves battery power by placing on standby, low power mode, or disabling entirely GPS signal acquisition circuitry and other associated devices, e.g., all or a portion of amplifier block **120** including power amplifiers, LNAs, switches, and the like. Furthermore, during supplemental location coordinates tracking, e.g., electronic device proximity measurements, the transceiver circuitry (e.g., transceiver **102**, location tracking circuitry **114**, and signal processing circuitry **104**) consumes reduced battery power for GPS circuitry while the electronic tracking device **100** communicates displacement vectors (e.g., differential location coordinates) to monitoring station **110** (e.g., a mobile phone, a personal digital assistant) through a wireless network **140**. As described above, when GPS signaling is not practicable, electronic device proximity measurements provide differential location coordinate information to calculate current location coordinate information.

In one embodiment, accelerometer, e.g., accelerometer **130**, determines if electronic tracking device **100** in a stationary position for a period, for instance, designated by system administrator or user. For example, electronic tracking device **100** may be, for example, located on a counter top, within a pocket of clothing, or inside a suitcase, not being moved, or not currently in use. Continuing with this embodiment, electronic tracking device **100** communicates a code, e.g., a stationary acknowledgement code, to communication network, e.g., wireless network **140**. In one variant, when or if monitoring station **110** requests location data through communication network, electronic tracking device **100** determines located in a stationary or substantially stationary position and electronic tracking device **100** communicates its last-known location to the monitoring station **110** without accessing or requiring GPS signaling or active GPS circuitry, e.g., location tracking circuitry **114**. Advantageously, in this embodiment, when electronic tracking device **100** does not utilize and require GPS circuitry, e.g., location tracking circuitry **114**, or functionality, the power resources are preserved of battery **118** in contrast to many conventional GPS communication system continuing power-on GPS circuitry. In one embodiment, electronic tracking device **130** associated with a person or object remains at a substantially stationary position approximately one-forth to one-third of a calendar day; thus, this feature of not accessing GPS circuitry preserves battery power.

In another embodiment, an accelerometer, such as accelerometer **130**, detects tapping against electronic tracking device **100**. For instance, upon wake-up, user prompt, system administrator prompt, or active, accelerometer **130** detects a person or object tapping a sequence on electronic tracking device **100**. In one embodiment, electronic tracking device **100** includes digital signal programming circuitry (such as of signal processing circuitry **104**). The digital signal programming circuitry recognizes programmed motions received by accelerometer, such as accelerometer **130**, and transmits an alert message to the monitoring station **110** upon receiving a recognized motion pattern. For example, electronic tracking device **100** may be programmed to recognize an "SOS tap cadence". Thus, if electronic tracking device **100** is repeatedly tapped, for instance, in a "dot-dot-dot, dash-dash-dash, dot-dot-dot" pattern, signal processing circuitry **104** recognizes a motion pattern and transmit an alert message to wireless network **114** to monitoring station **110**. In one instance, alert message may be associated as a distress pattern and will require an appropriate response. In one variant, the accelerometer may recognize when an object or individual spins or turns motion of electronic tracking device **100**. Continuing with this embodiment, signal processing circuitry **104** recognizes programmed motions, and transceiver **102** transmits an alert message to wireless network **114** associated with programmed motions. In another variant, electronic tracking device **100** is programmed to recognize other motion patterns, such as, when it is tumbled or flipped. Depending upon on duration, time, or cadence of these movements or motion patterns, electronic tracking device **100** communicates an alert message to the wireless network **114**. In one variant, wireless network **114** performs an appropriate action, such as communicating information signal to monitoring station **110**.

In another example, physical impacts on electronic tracking device **100** are measured to determine if an individual or object may be injured. In one embodiment, magnitude of displacement vectors may be measured by one or more accelerometers, such as accelerometer **130**, disposed at various inclinations and orientations, e.g., disposed substantially orthogonal to one another. Continuing with this embodiment, when a measured physical impact is above a predetermined level, an object or individual associated with electronic tracking device **100** may have suffered a fall or be in need of medical attention. In one variant of this embodiment, a user (e.g., a system administrator, or person located in a contact book) at monitoring station **110** becomes alerted, e.g., by text message, email, or voice mail (as more fully described in previously incorporated by reference U.S. patent application Ser. No. 11/935,901 filed on Nov. 6, 2007, entitled "System and Method for Creating and Managing a Personalized Web Interface for Monitoring Location Information on Individuals and Objects Using Tracking Devices"). In one variant of this embodiment, if a user does not affirmatively respond, another individual, guardian, medical personnel, or law enforcement officer is contacted by monitoring station **110** (as more fully described in Ser. No. 11/935,901). In yet another variant of this embodiment, monitoring station **110** continues to contact individuals until the alert message is affirmatively answered.

Battery Conservation

Referring to FIG. **3**, a flow chart **300** illustrates battery conservation for electronic tracking device **100** as described in FIGS. **1**, **2** in accordance with one embodiment of the present invention. In step **302**, antenna **122*a*** associated with electronic tracking device **100** acquires a snapshot of receive communication signal including location coordinates data. In step **304**, processing unit **104** processes the snapshot of receive communication signal including location coordinates data. In step **306**, processing unit **104** determines a power level of receive communication signal. In step **308**, accelerometer **130** activates if a power level of the receive communication signal is insufficient for processing. In one variant of step **308**, accelerometer **130** measures acceleration of electronic tracking device **100** at time intervals, e.g., T1, T2, T3 . . . TN.

In step **310**, processing unit **104** computes current location coordinates using acceleration measurements. In step **312**, all or a portion of amplifier block **120** and associated circuitry, e.g., location tracking circuitry, are activated at selected time intervals to determine if receive communication signal is of sufficient signal strength. In one variation of step **312**, upon determining receive communication signal of sufficient signal strength, location tracking circuitry **114** are activated, and processing unit **104** determines location coordinates from the receive communication signal. In another variation of step **312**, upon determining receive communication signal of sufficient signal strength, accelerometer **130** is deactivated and location tracking circuitry **114** are activated, and processing unit **104** determines location coordinates from the receive communication signal.

User Adjustable Location Coordinate Refresh Rate

Referring to FIG. **4**, screen display **400** illustrates a user definable adjustable location coordinate refresh rate in one embodiment of the present invention. As best illustrated in FIG. **5**, schematic **500** illustrates communication of location coordinate refresh rate between portable electronic tracking device **402** and satellite navigation system **403** in accordance with an embodiment of the present invention.

In one embodiment, portable electronic tracking device **402** monitors location coordinates of one or more individuals and objects using satellite navigation system **403**. Portable electronic tracking device **402** includes battery **118** having battery charge level **406** displayed on screen display **400** of personal communication device **404** (e.g., mobile phone, wireless digital assistant, laptop computer, personal computer and the like). Other components of portable electronic tracking device **402** include transceiver **102**, signal processing circuitry **104**, battery level monitor **116**, signal processing circuitry **104**, location tracking circuitry **114**, adj **416**, and battery charging circuitry **128**.

In one example, battery level monitor **116** measures in real-time battery charge level **406**. In one embodiment, battery level monitor **116** predicts, for instance, estimated remaining battery charge life **414** in response to battery charge level **406**. This estimation or prediction may be based on standard techniques know by those skilled in the art at the time of this disclosure including measurement of time average amperage draw and voltage level (over a given period) to estimate remaining battery charge life **414**.

In one embodiment, local battery power adjustment mechanism **416** generates in substantially real-time updated set of network communication signaling protocols. In one variant, updated set of network communication signaling protocols communicated, for instance, includes an update rate (e.g., refresh rate) of location coordinate packets **446**. In one example, update rate of location coordinate packets **446** includes request rate **420** of location coordinate packets **422** by target host **452** (e.g., a computer server) and/or listen rate **425** of location coordinate packets **422** by portable electronic tracking device **402**. Updated set of network communication signaling protocols, for instance, has value (e.g., X Y Z) responsive to user input request **430**.

In one embodiment, to conserve battery power when communicating messages between target host **452** and portable electronic tracking device **402**, local battery power adjustment mechanism **416**, for instance, remotely by personal communication device **404** communicates a message to active or deactivate a portion of transceiver circuitry **102** or processor circuitry **104** or location tracking circuitry **114** to conserve battery charge level **406** responsive to value **419** (e.g., a user input screen control or mouse adjustable cursor value). In one variant, local battery adjustment mechanism **416** includes user adjustable screen icon **432** to graphically display in substantially real-time trade-off relationships between remaining battery charge level **414** and update rate **446** (e.g., refresh rate) of location coordinate packets **422**. Advantageously as compared to conventional tracking devices, user input request **430** adjusts value **419** to select an appropriate update set of network communication signaling protocols to achieve a desired user defined battery operating environment, e.g., obtain optimal battery life, obtain optimal update rate, tradeoffs between them. In one embodiment, when user adjusts slider **432** to value **419**, a message is sent to target host **452**, which communicates an updated set of network communication to portable location tracking device **402**.

In response to receipt of updated set of network communication signaling protocols, portable location tracking device **402** adjusts settings (an internal time schedule) and acknowledges receipt of the message to target host **452**. Portable location tracking device **402** checks internal time schedule to determine if it should listen for (perform a location lookup of) location coordinates **422** from satellite navigation system **403** or an adjacent portable location coordinate tracking device (as shown in FIG. **6**) as more fully described in, for instance, U.S. patent application Ser. No. 11/753,979 filed on May 25, 2007, which has been previously incorporated by referenced and claimed priority to. Portable location tracking device **402** obtains location coordinates **422** and stores, for instance, in one or more internal breadcrumb memory location(s). Based on the internal time schedule, portable location tracking device **402** determines whether to transmit contents of the one or more breadcrumb memory location(s) to target host **452**.

Upon transmission of contents, target host **452** acknowledges receipt of contents of one or more breadcrumb memory locations. In one variant, target host **452** issues a command to flush one or more breadcrumb memory locations. In this same variant, portable electronic tracking device **402** flushes its internal breadcrumb memory and acknowledges completion of the command to the target host **452**. In another variant, target host **452** issues a stack pointer adjustment command to acknowledge receipt of previously submitted contents of breadcrumb memory locations and to move stack pointer to an adjacent or an alternative breadcrumb memory location to signal that these memory location have been uploaded by target host **452**.

In another embodiment, local battery adjustment mechanism **416** includes timing adjustment mechanism **446** adjusting, for instance, request rate **420** of location coordinate packets **422** to target host **452** and listen rate **425** of location coordinates **422** in accordance with a current location coordinate position of portable tracking device **402**. In one variant, local battery adjustment mechanism **416** includes user adjustable electronic display **432** that indicates current level of battery **406** and allows user a capability to adjust power level thereof. In one variant of this embodiment, local battery adjustment mechanism **416** includes automatic or semi-automatic sleep mode **448**. In one embodiment, automatic or semi-automatic sleep mode **448** sets to a minimal level request rate **420** of location coordinate packets **422** to target host **452** and listen rate **425** of location coordinates **422** until battery power monitor **116** measures, for instance, a sustainable battery charge level to sustain operation of portable electronic tracking device **402**.

In one embodiment, local battery adjustment mechanism **416** includes charge control management (e.g., adj **416**) of portable electronic tracking device **402** that estimates charge capability (e.g., battery charge remaining **414**) and adjusts cycling of one or more of request rate **420** of location coordinate packets **422** to target host **452** and listen rate **425** of location coordinate packets **422** to maximize charge capability. In one alternative embodiment, local battery adjustment mechanism (e.g., adj **416**) includes cycle management apparatus **416** to set up, for example, timing schedule (e.g., refresh rate **446**) to maximize effectiveness of request rate **420** and listen rate **425** in response to substantially real-time measured velocity of travel of portable electronic tracking device **402**.

Referring to FIGS. **5** and **6**, system **500** and system **600** respectively include local charging management device (e.g. local battery adjustment mechanism **416**) manages electrical resource capability for an electronic tracking device **402** that is tracked by at least one other tracking device (e.g., devices

403, **405**, **407**, **409**). In one embodiment, tracking device (e.g., portable electronic tracking device **402**) includes a battery level monitor **116** remotely located for charging unit (e.g., battery charging circuitry **128**), adj **416** (e.g., electrical power resource management component, local battery adjustment mechanism **416**). In one variant, electrical power resource management component adjusts cycle timing of request rate **420** of location coordinate packets **422** to target host **452** and listen rate **425** of location coordinate packets **422** from satellite navigation system **403** responsive to estimated charge level of charging unit (e.g., battery charge level **406**).

In one embodiment, electrical power resource management component (e.g., local battery adjustment mechanism **416**) includes a substantially real-time user viewable display icon **432** that indicates estimate charge level (e.g., battery level **406**) and provides an on-line user adjustable cursor display **432** (see FIG. **4**). In one example, on-line cursor display **432** adjusts one or more of: request rate **420** of location coordinate packets **422** to target host **452** and listen rate **425** and gives substantially automatic updated estimated charge level of the charging unit (e.g., battery charging circuitry or unit **128**). In one variant, local battery management device **416** includes charge control management of electronic tracking device **402** that estimates charge capability and adjust cycling of request rate **420** of location coordinate packets **422** to host target **428** and listen rate **425** of location coordinate packets **422** from satellite navigation system **403** or alternatively an adjacent portable location tracking device to maximize charge capability.

In yet another embodiment, local charging management device **416** includes cycle management apparatus to set up timing schedule **446** to maximize effectiveness of request rate **420** and listen rate **425** in response to measured velocity of travel portable electronic tracking device **402**. In one variant, local charging management device **416** electrically coupled through personal communication device **404** sets up timing schedule **446** between one or more than one wireless communication networks to communicate information between portable electronic tracking device **402**. In one example of this embodiment, listen rate **425** of location coordinate packets **422** to the host target **428** and response rate **425** includes global positioning system (GPS) system refresh rate **446**.

Advantageously as compared to prior global positioning systems having manufactured defined power settings, the current invention power charging monitor (e.g., battery level monitor **116**) measures a power level (e.g., battery power level **406**) of the power charging unit (e.g., battery level monitor **116**) and substantially automatically adjusts power usage responsive to available power of power charging unit to maximize power life.

In yet another advantage, the present invention power charging monitor (e.g., battery level monitor **116**) measures a power level (e.g., battery power level **406**) of power charging unit (e.g., battery **118**) and adjusts a power level (e.g., battery power level **406**) applied to, for example, location tracking circuitry (e.g., location tracking circuitry **114**) or transceiver **102** responsive to one or more signal levels. In contrast to previous manufacturer tracking device power level settings, the present invention has the capability of power level (e.g., battery power level **406**) adjustments include multitude of threshold values (see active display **432** of FIG. **4**) that is determined by user or system administrator to intermittently activate or deactivate location tracking circuitry (e.g., location tracking circuitry **114**) to conserve power of the power charging unit (e.g., battery **118**) responsive to estimated charge level (e.g., battery charge level **406**).

In a first example, a lost dog has portable location tracking device **402**. Using the present invention, a user, e.g., a dog owner, will adjust a slider level, such as using on-line cursor display **432**, to a high update rate interval. For instance, the high setting corresponds to 15 minute intervals for location and 15 minute intervals for transmission to target host, e.g., server. The server sends these settings to portable location tracking device **402** and portable location tracking device **402** adjusts its settings and acknowledges the message. As such, portable location tracking device **402** will perform frequent updates of its location coordinates from a satellite navigation system and will transmit frequently its location coordinates to a target host. Thus, advantageously, with this setting, a user will probably more rapidly locate a missing or lost pet. With this setting, battery life will be relatively short.

In a second example, a teenager borrows a parent's car having portable location tracking device **402**. Using the present invention, users, e.g., parents, desire to know if their teenager is driving safely in designated areas or locations, but does not want to track the teenager's location in real-time. In this case, the parents adjust a slider level, such as using on-line cursor display **432**, to a medium update rate interval. For instance, the medium setting corresponds to 15 minute intervals for location and 60 minute intervals for transmission to the target host, e.g., server. The server sends these settings to portable location tracking device **402** and portable location tracking device **402** adjusts its settings and acknowledges the message. As such, portable location tracking device **402** will perform frequent updates of its velocity and location coordinates from a satellite navigation system and will less frequently transmit its location coordinates to a target host. As long as the teenager remains in allowed areas and traveling at allowed speeds, the portable location tracking device will not transmit frequently. Fortunately, during these infrequent transmissions, portable location tracking device will transmit its location history. Thus, advantageously, with this setting, parents can see history at many locations while still preserving battery life, e.g., longer life than first example.

In a third example, a provider of construction equipment having portable tracking device **402** rents the equipment to contractors. Using the present invention, a user, e.g., provider desires to know location of the equipment once per day. In this case, the provider adjusts a slider level, such as using on-line cursor display **432**, to a low update rate interval. For instance, the low setting corresponds to 1440 minute intervals (24 hours) for location coordinates and 1440 minute intervals (24 hours) for transmission to the target host, e.g., server. The server sends these settings to portable location tracking device **402** and portable location tracking device **402** adjusts its settings and acknowledges the message. As such, portable location tracking device **402** will perform infrequent updates (once per day) of location coordinates from a satellite navigation system and will less frequently transmission (once per day) of its location coordinates to a target host. Thus, advantageously, with this setting, portable location coordinate device will realize increased battery life, e.g., longer life than first and second examples.

User Adjustable Power Level Monitor Flow Chart

Referring to FIG. **7**, flow chart **700** illustrates user definable adjustable conservation power level monitor for portable electronic tracking device **402** as described in FIGS. **4**, **5**, and **6** in accordance with one embodiment of the present invention.

In step **702**, user receives measured charging unit power level of tracking device **402** communicated by a location coordinate tracking system **403**. In step **704**, system administrator, user, automatic or semi-automatic program software

adjusts charging unit power level of tracking device **402** in response to a substantially-real life estimate of the unit power level **406** of a charge unit **118** of tracking device **402**.

In step **706**, system administrator, user, automatic or semi-automatic power monitoring software program creates an initial timing schedule **446** including communication of signaling parameters associated with a request rate **420** communicated with location coordinate information **422** and listen rate **425** of location coordinate information **422**. In one variant of step **706**, initial timing schedule **446** was at least partially automatically and responsive to an estimated power level **414** of the charge unit **118**.

In step **708**, user readjusts the initial timing schedule **446** for communication of signaling parameters in accordance with a local request by remote user using an Internet accessible icon **432** that displays user viewable tradeoffs between the estimated charge unit life and charge unit update rate. In one variant of step **708**, remote user uses a mouse to enter an on screen cursor value **419** that is associated with a tradeoff of estimated charge life **414** and an update rate **446** of location coordinate information **422**.

It is noted that many variations of the methods described above may be utilized consistently with the present invention. Specifically, certain steps are optional and may be performed or deleted as desired. Similarly, other steps (such as additional data sampling, processing, filtration, calibration, or mathematical analysis for example) may be added to the foregoing embodiments. Additionally, the order of performance of certain steps may be permuted, or performed in parallel (or series) if desired. Hence, the foregoing embodiments are merely illustrative of the broader methods of the invention disclosed herein.

While the above detailed description has shown, described, and pointed out novel features of the invention as applied to various embodiments, it will be understood that various omissions, substitutions and changes in the form and details of the device or process illustrated may be made by those skilled in the art without departing from the spirit of the invention. The foregoing description is of the best mode presently contemplated of carrying out the invention. This description is in no way meant to be limiting, but rather should be taken as illustrative of the general principles of the invention. The scope of the invention should be determined with reference to the claims.

What is claimed is:

1. A portable electronic tracking device to monitor location coordinates of one or more individuals and objects using a satellite navigation system, the portable electronic tracking device comprising:

a battery having a battery charge level;

transceiver circuitry;

processor circuitry;

a battery power monitor to measure in real-time the battery charge level and to make a prediction of an estimated remaining battery charge level in response to the battery charge level;

local battery power adjustment mechanism to generate in substantially real-time an updated set of network communication signaling protocols associated with at least one of a request rate of location coordinate packets to be communicated to a target host and a listen rate of the location coordinate packets from a satellite navigation system, the updated set of network communication signaling protocols having a value that is responsive to a user input request;

wherein the local battery power adjustment mechanism actives or deactivates at least one portion of the transceiver circuitry or the processor circuitry to conserve the battery charge level in response to the value.

2. The device of claim **1**, wherein the local battery power adjustment mechanism comprises an adjustable screen icon to graphically display in substantially real-time a trade-off relationship between the remaining battery charge level and an update rate of the location coordinate packets that is in response to the updated set of network communication signaling protocols.

3. The device of claim **1**, wherein the local battery power adjustment mechanism comprises a timing adjustment mechanism that adjusts the at least one of the request rate of the location coordinate packets to the target host and the listen rate of the location coordinates from a satellite navigation system in accordance with a current position of the tracking device.

4. The device of claim **1**, wherein the local battery power adjustment mechanism comprises a user adjustable electronic display that indicates a current level of battery power and allows a user a capability to adjust power level thereof.

5. The device of claim **4**, wherein the local battery power adjustment mechanism comprises an automatic sleep mode to set at least one of the request rate of the location coordinate packets to the target host and the listen rate of the location coordinates from the satellite navigation system to a minimal level until the battery power monitor measures a sustainable battery charge level to process the at least one portion of an receive signal.

6. The device of claim **4**, wherein the local battery power adjustment mechanism comprises a charge control management of the portable electronic tracking device that estimates charge capability and adjusts cycling of the at least one of a request rate of location coordinate packets to a target host and a listen rate of the location coordinate packets from the satellite navigation system to maximize charge capability.

7. The device of claim **1**, wherein the local battery power adjustment mechanism comprises a cycle management apparatus to set up a timing schedule to maximize effectiveness of the request rate and the listen rate in response to a substantially real-time measured velocity of the portable electronic tracking device.

8. A local charging management device to manage electrical resource capability for an electronic tracking device that is tracked by at least one other tracking device comprising:

a battery power level monitor;

a charging unit; and

an electrical power resource management component to adjust cycle timing of at least one of a request rate of location coordinate packets to a target host and a listen rate of the location coordinate packets responsive to an estimated charge level of the charging unit,

wherein the battery power level monitor measures a power level of the charging unit and adjusts a power level applied to location tracking circuitry responsive to one or more signal levels, the power level comprising a multitude of threshold values determined by a user or system administrator to intermittently activate or deactivate the location tracking circuitry to conserve power of the charging unit in response to the estimated charge level of the charging unit.

9. The apparatus of claim **8**, wherein the electrical power resource management component comprises a substantially real-time user viewable display icon that indicates the estimated charge level and provides an on-line user adjustable cursor display that adjusts at least one of the request rate of the location coordinate packets to the target host and the listen

rate of the location coordinate packets and gives substantially automatic updated estimated charge level of the charging unit.

10. The apparatus of claim **8**, wherein the local charging management device comprises a charge control management of the portable electronic tracking device that estimates charge capability and adjusts cycling of the at least one of a request rate of location coordinate packets to a host target and a listen rate of the location coordinate packets to maximize charge capability.

11. The apparatus of claim **8**, wherein the local charging management device comprises a cycle management apparatus to set up a timing schedule to maximize effectiveness of the request rate and listen rate responsive to measured velocity of the portable electronic tracking device.

12. The apparatus of claim **11**, wherein the local charging management device electrically couples to a mobile phone to remote control the local apparatus to setup a timing schedule from a multitude of wireless communication networks to communicate information between the electronic tracking device and the mobile phone.

13. The apparatus of claim **8**, wherein the listen rate of the location coordinates comprises a global positioning system (GPS) system refresh rate of the location coordinates.

14. The apparatus of claim **8**, wherein the request rate and the listen rate are set remotely by a user using a mobile phone or wireless communication device.

15. The apparatus of claim **8**, wherein the battery power level monitor measures a power level of the charging unit and substantially automatically adjusts power usage responsive to available power of the charging unit to maximize power unit life.

16. A method to control power usage comprising:

measuring charging unit power level of a tracking device communicated by a location coordinate tracking system;

adjusting charging unit power level of the tracking device in response to a substantially-real life estimate of a unit power level of a charge unit of the tracking device;

creating an initial timing schedule for communication of signaling parameters associated with a target host request rate communicated with location coordinate information and listen rate of the location coordinate information, the initial time schedule being at least partially automatically and responsive to an estimated power level of the charge unit; and

readjusting the initial timing schedule for communication of signaling parameters in accordance with a local request by a remote user using an Internet accessible icon that displays user viewable tradeoffs between an estimated charge unit life and a charge unit update rate.

17. The method of claim **16**, wherein creating an initial timing schedule for communication of signaling parameters comprises creating a management schedule for setting a rate at which messages are exchanged between the tracking device and a target host.

18. The method of claim **16**, wherein creating an initial timing schedule for communication of signaling parameters comprises creating a management schedule for setting a rate at which messages are exchanged between a navigational satellite system and the tracking device to a local device to maximize effectiveness of the request rate and the listen rate to the location coordinate information in response to a measured velocity of the tracking device.

19. The method of claim **16**, wherein readjusting the timing schedule for communication of signaling parameters in accordance with a local request by a remote user comprise electrically coupling the tracking device to a mobile phone to remote control cycling the location coordinates to setup up a timing schedule between a multitude of wireless communication networks to communicate information between the electronic tracking device and the mobile phone.

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CERTIFICATE OF SERVICE

I hereby certify that on July 16, 2024, I served a copy of the foregoing brief on all counsel of record via this Court's CM/ECF system.

Dated: July 16, 2024

/s/ Jaysen S. Chung

Jaysen S. Chung, *Principal Attorney*
GIBSON, DUNN & CRUTCHER LLP
One Embarcadero Center, Suite 2600
San Francisco, CA 94111
(415) 393-8271

CERTIFICATE OF COMPLIANCE

1. This brief complies with the type-volume limitation of Federal Circuit Rule 32(b)(1) because it contains 10,006 words, excluding the parts of the brief exempted by Federal Circuit Rule 32(b)(2) and Rule 32(f) of the Federal Rules of Appellate Procedure.

2. This brief complies with the typeface and type-style requirements of Federal Rules of Appellate Procedure 32(a)(5) and 32(a)(6) because it has been prepared in a monospaced typeface using Microsoft Word 2019 in 14-point Times New Roman font.

Dated: July 16, 2024

/s/ Jaysen S. Chung

Jaysen S. Chung
GIBSON, DUNN & CRUTCHER LLP
One Embarcadero Center, Suite 2600
San Francisco, CA 94111
(415) 393-8271